The AAPT/APS Joint Task Force on Undergraduate Physics Programs (J-TUPP)

Dr. Quinton L. Williams
Chair and Professor of Physics
Howard University
Purpose of an Undergraduate Physics degree

A degree in physics is designed to increase one’s understanding of nature and its workings which are grounded in scientific principles and terms.

"Enhancing the understanding and appreciation of physics through teaching"
J-TUPP Background

- Concern by departments about the future of physics programs
- Pressure from senior administrators to know best practices for teaching physics
- Need to change curriculum to meet needs of today’s students
  - Not all go to graduate school
  - Curriculum has been the same for 60 years
contd…

- Undergraduate curriculum task force work started in 2012
- APS and AAPT saw value in partnering to address the needs of physics departments
- AAPT approved J-TUPP at SM13
- APS approved J-TUPP in Fall 2013

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J-TUPP Charge

• To prepare a report that will engage and inform physicists in answering the question:

“What skills and knowledge should the next generation of undergraduate physics degree holders possess to be well prepared for a diverse set of careers?”
J-TUPP Members

- Paula Heron, co-chair, University of Washington
- Laurie McNeil, co-chair, University of North Carolina, Chapel Hill
- Douglas Arion, Carthage College
- Walter Buell, Aerospace Corporation
- S. James Gates, University of Maryland
- Sandeep Giri, Google
- Elizabeth McCormack, Bryn Mawr College
- Helen Quinn, Stanford Linear Accelerator Center
- Quinton L. Williams, Howard University
- Lawrence Woolf, General Atomics Aeronautical Systems
Society Liaisons

- Beth Cunningham, AAPT
- Renee Michelle Goertzen, APS
- Bob Hilborn, AAPT
- Theodore Hodapp, APS

- Liaison to AAPT Undergraduate Curriculum Task Force: Ernie Behringer

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Summary of 1st Face-to-Face J-TUPP Meeting

- 2-day Meeting held in mid Nov. 2014 at ACP
- Group Discussion of the Charge
- Boundaries set for Intent of the Report
- Physics Employment Data presented by AIP (Roman Czujko)
- Report Outline and Writing subgroups formed
- Timeline developed

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Summary of 2nd Face-to-Face J-TUPP Meeting

- 2-day Meeting held in mid Apr. 2015 in Baltimore
- Re-visited the Charge of JTUPP
- Subgroups Reported Out to the full Task Force
- Video Conferences with industry – Texas Instruments and Google
- Various Speakers (i.e., Intellectual Property Expert, Survey Results from employers and recent graduates)
- New Tasks and Writing Assignments given
- Timeline Revised

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Timeline

- 1\textsuperscript{st} face-to-face meeting - mid-Nov. 2014
- 2\textsuperscript{nd} face-to-face meeting - mid-Apr. 2015
- Input from physics community in 2015
  - AAPT WM15 and SM15
  - APS March and April Meetings
- JTUPP Virtual Conf. – July 2015
- 3\textsuperscript{rd} face-to-face meeting – mid-Dec. 2015
- Final Draft – Dec. 2015
- Physics Community Feedback on report - Mar and Apr Meetings 2016
- Final report anticipated in late 2016

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AAPT Undergraduate Curriculum Task Force (UCTF) Charge

- The UCTF is charged with developing specific, multiple recommendations for coherent and relevant undergraduate curricula (including course work, undergraduate research, mentoring, etc.) for different types of physics majors in collaboration with the APS and AIP, and with developing recommendations for the implementation and assessment of such curricula.

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Goal of the UCTF Subcommittee

• Develop a set of curriculum recommendations (objectives, experiences, learning outcomes) for the introductory and advanced (i.e. beyond first year) labs that **foster the development of many key 21st century skills and competencies.**

UCTF Anti-Charge

NOT to develop a “one-size-fits nobody” curriculum
NOT to develop standardized tests
NOT to become an accrediting body

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UCTF Report

• Provide guidance for revising the undergraduate curriculum to improve the education of a diverse student population. Recommendations on:
  ➜ content
  ➜ pedagogy
  ➜ professional skills
  ➜ student engagement

• Describe documentable student outcomes
AIP Employment Statistics

Status of Physics Bachelor’s in the US One Year After Degree, 1995 through 2012

Percent
60
50
40
30
20
10
0

Class of

http://www.aip.org/statistics

Workforce
Physics or Astronomy Graduate Study
Graduate Study in Other Fields
Employment Sectors for Recent Physics B.S. graduates

- Engineering: 32%
- Computer or Information Systems: 21%
- Physics or Astronomy: 5%
- Other Stem: 16%
- Non-STEM: 26%

contd...
How is career preparedness defined?

Education (24%), skills (23%), personal traits (17%) and experience (16%) are cited most often as part of the definition of preparedness by all audiences (>3,100 respondents).

Soft skills are at the top of the list:

INTEGRITY is most important, with eight in ten business leaders saying it is very important for success in the workplace (84% of business decision-makers and 78% of corporate recruiters).

Other highly-prized soft skills: PROFESSIONALISM (75%), POSITIVE ATTITUDE (75%), ORAL COMMUNICATION SKILLS (71%) and WORKING WELL AS A TEAM PLAYER (71%).
Employment Outlook in Physics

- Physics graduates are among the top 10 highest paid undergraduate majors.

Median mid-career pay: $101,000
Median starting salary: $49,800

The American Institute of Physics reports that those with a physics degree find work in organizations ranging from corporations, universities, high schools and hospitals to the U.S. military, museums, publishing firms, domestic and foreign governments and laboratories.
Knowledge and Skills Regularly Used by Physics Bachelor's Employed in the Private Sector, Classes of 2009 & 2010 Combined

<table>
<thead>
<tr>
<th>Skill</th>
<th>Engineering</th>
<th>Computer Science or Information Technology</th>
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<tbody>
<tr>
<td>Solve Technical Problems</td>
<td>85%</td>
<td>80%</td>
</tr>
<tr>
<td>Work on a Team</td>
<td>60%</td>
<td>75%</td>
</tr>
<tr>
<td>Technical Writing</td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td>Knowledge of Phys. or Ast.</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td>Perform Quality Control</td>
<td>75%</td>
<td>70%</td>
</tr>
<tr>
<td>Use Specialized Equip.</td>
<td>75%</td>
<td>80%</td>
</tr>
<tr>
<td>Design &amp; Development</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>Programming</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>Manage Projects</td>
<td>50%</td>
<td>60%</td>
</tr>
<tr>
<td>Work with Customers</td>
<td>40%</td>
<td>50%</td>
</tr>
<tr>
<td>Advanced Math</td>
<td>30%</td>
<td>40%</td>
</tr>
<tr>
<td>Simulation or Modeling</td>
<td>30%</td>
<td>40%</td>
</tr>
<tr>
<td>Computer Admin.</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>Manage People</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Manage Budgets</td>
<td>10%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Percentages represent the physics bachelor's who chose "daily", "weekly", or "monthly" on a four-point scale that also included "never or rarely".

http://www.aip.org/statistics
J-TUPP Recommendations WILL NOT:

- Prescribe a curriculum
- Prescribe particular labs the students should do
- Provide a list of required equipment
- Develop or prescribe particular assessments for lab courses
- Develop a separate set of guidelines for online labs

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Conclusion

What J-TUPP Wants from You…

• What weighs heavily on department minds regarding preparation of undergraduate physics majors?

• What can J-TUPP do to help out departments with these concerns?

Thank you!