

# NSF ATE Grant #1501499

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BOROUGH OF MANHATTAN COMMUNITY COLLEGE

# ATE = Advanced Technological Education

- ▶ Emphasis on two-year colleges
- ▶ Focuses on education of technicians for high-tech fields
- ▶ Involves partnerships between academic institutions and industry to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels.
- ▶ Another goal is articulation between two-year and four-year programs for K-12 prospective STEM teachers that focus on technological education. The program invites research proposals that advance the knowledge base related to technician education.

## The ATE program supports

- ❑ Curriculum development
- ❑ Professional development of college faculty and secondary school teachers
- ❑ Career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions
- ❑ Additional activities

# A Simulation-Based Curriculum to Accelerate Math Remediation and Improve Degree Completion for STEM Majors

- ▶ \$875,000 NSF Grant to create digital games for algebra
- ▶ Includes a games and exploration based summer bridge program to encourage student to explore technical careers such as GIS
- ▶ Created by expert game designers

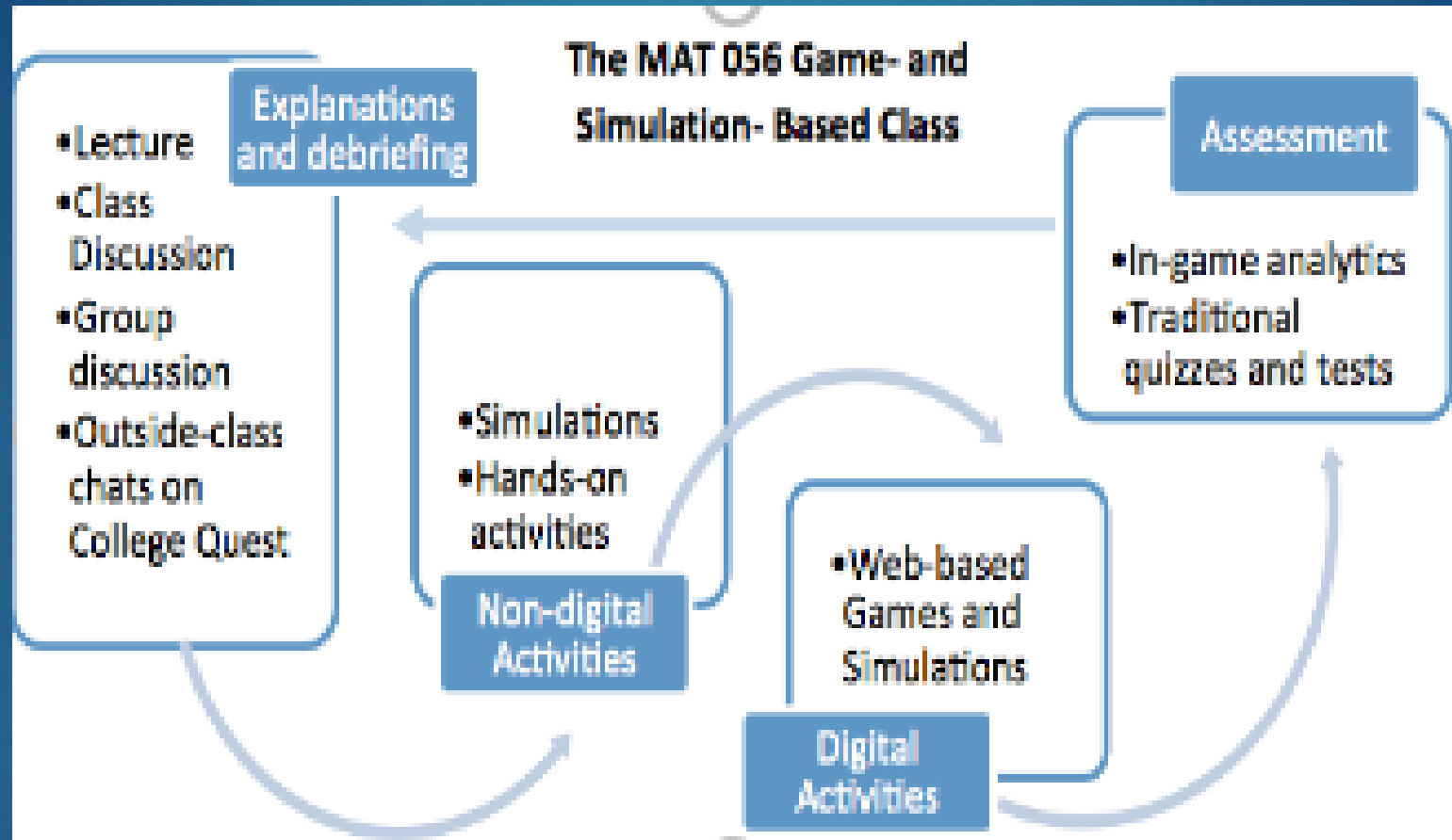
# How did we get this award?

- ▶ Persistence ! This was my 5<sup>th</sup> time applying to the NSF with variations of this grant.
- ▶ The support of BMCC's office of grants "Faculty Fellows" Program
- ▶ Luck! The program officer's area is GIS. He gave us a chance to answer some further questions in an addendum to the grant application.
- ▶ Excellent Writing! It helps to have a co-PI who is an English Professor. 😊 Charts, graphs and tables spelling out *exactly* what you are going to **do** are essential.

# Objectives Aligned with ATE

Project Objectives	ATE Objectives
<p><b>Develop a game-based curriculum for a summer intensive version of MAT 056 that incorporates custom-designed digital games and simulations and serves 280 students by end of grant. The course will be paired with a section of GEO 100 to provide students with a head start toward a GIS degree.</b></p> <p><b>Games and simulations in the MAT 056 curriculum will:</b></p> <ul style="list-style-type: none"> <li>• <b>Be keyed to course learning outcomes.</b></li> <li>• <b>Model real-world algebraic applications created with advice from technical experts in GIS and other STEM fields</b></li> </ul>	<p>“...[A]ffect the learning environment, course content, and experience of instruction for students preparing to be science and engineering technicians and for their teachers.”</p> <p>“...[D]evelop new print, electronic, and multimedia materials, including simulations, scenarios, and web-based collections as well as laboratory experiments and manuals.”</p> <p>“...[P]roducts will be developed with input from business, industry, and government, validated by experts from these organizations....”</p>
<p><b>2. Target students entering the GIS major or other technical STEM major at BMCC. This effort will specifically target our Geographic Information Science major, but students who wish to major in other technical fields offered at BMCC (e.g., Engineering Science, Multimedia Programming, Computer Information Systems, Computer Network Technology, Biotechnology, Forensic Science, and Video Arts and Technology) will also be welcome.</b></p>	<p>“Fields of technology supported by the ATE program include, but are not limited to, advanced manufacturing technologies, agricultural and bio-technologies, energy and environmental technologies, engineering technologies, information technologies, micro- and nano-technologies, security technologies, and learning, evaluation and research.”</p>

# Diagrams



# Timetable

## Part 6: Timetable

Activities	Year 1			Year 2			Year 3			Institution- alization
	Summer 2015	Fall 2015	Spring 2016	Summer 2016	Fall 2016	Spring 2017	Summer 2017	Fall 2017	Spring 2018	Summer 2018
Create the software and curriculum										
Refine the software and curriculum										
Recruit High School students										
Train faculty users										
Pilot the program with (x) students				(20)			(60)			
Prepare and implement GIS student support services										
Offer game-based MAT 066 to other BMCC students					(25)	(25)		(25)	(25)	
Disseminate results and materials										
Institutionalize the program										(100)
<b>Total students served</b>				<b>20</b>	<b>45</b>	<b>70</b>	<b>130</b>	<b>155</b>	<b>180</b>	<b>280</b>

# Students Engaged in Learning Math by Playing Games in Class









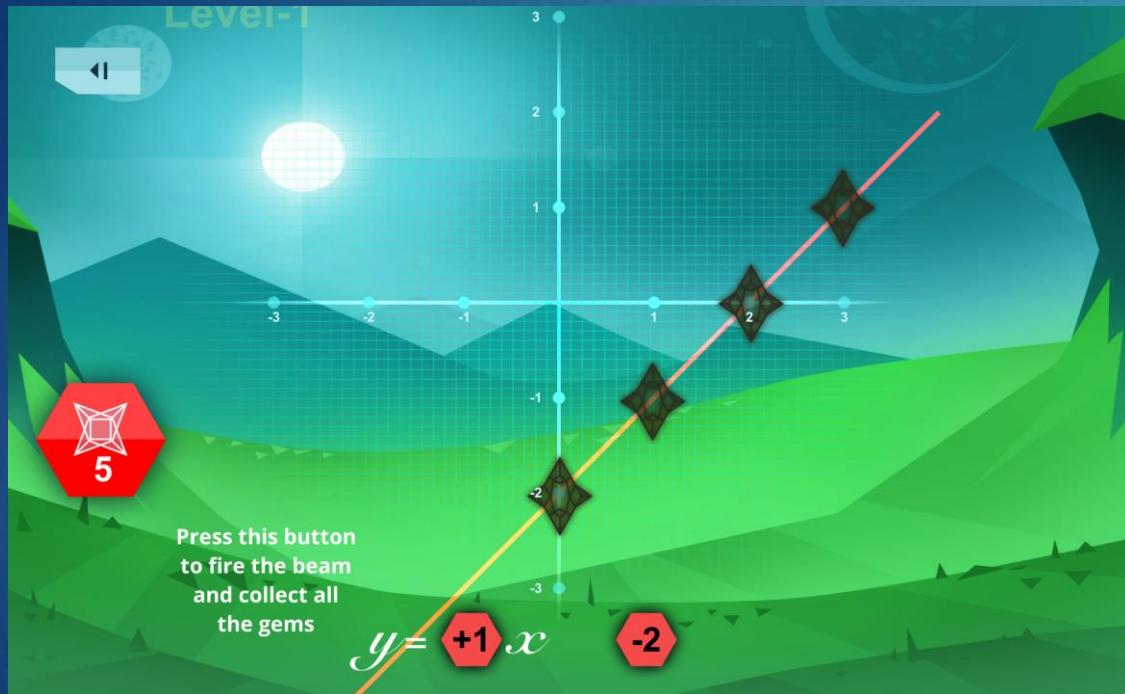
# Students' Feedback

- ▶ We learned basic equations. We learned the usefulness of slope, y-intercept, and equation line in a real-life situation. We learned how to use our knowledge about equation line in a plan to solve real-life issue. These games helped us to better understand the role of each variable in the equation line and how the line can change position in the plan according to the change of variable's account.
- ▶ In the first game we learned how each variable in the formula changed the slope of the line. In the second game we learned how to balance equations, and in the third game we learned how to apply math for the real-world situations.

# xPonum

12

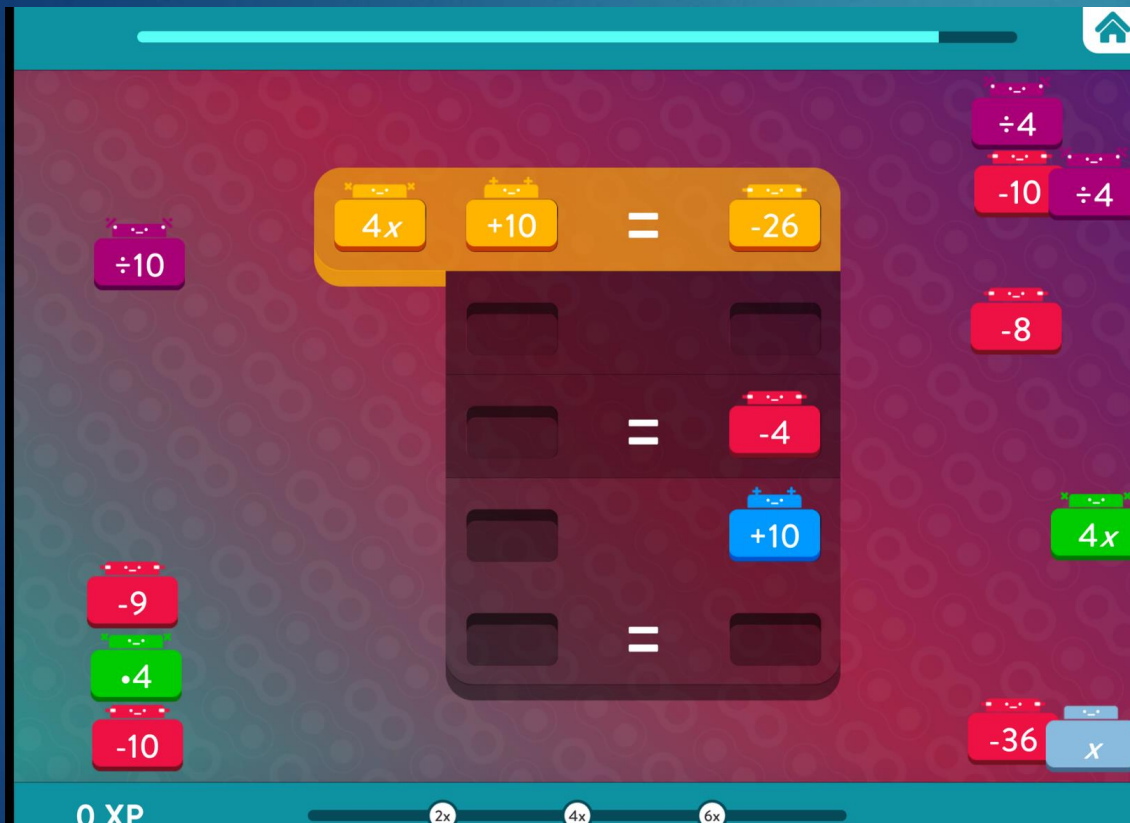
<https://levelfly.bmcc.cuny.edu/games/2>



- ▶ Students learn graphing and line shifts through exploration, great for beginning or intermediate algebra
- ▶ The first world is linear equations, the next, parabolas, and on to complex combinations of functions, for precalculus
- ▶ Key take-aways include that math is visual and can be learned by exploring

# Algebots

<https://levelfly.bmcc.cuny.edu/games/3>



- ▶ Students practice solving equations in puzzle form
- ▶ Equations range from basic equations to absolute value and quadratics
- ▶ Key take-aways include that what is done to one side *must* be done to the other
- ▶ Preliminary data shows this to be their favorite of the three games.

# Project Sampson

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<https://levelfly.bmcc.cuny.edu/games/4>



- ▶ Students experience real-life GIS context for graphs through resource management
- ▶ Equations of lines represent damage to supplies
- ▶ Key take-aways include that math is used in exciting contexts

# Interested in More?

- ▶ [Kathleenoffenholley@yahoo.com](mailto:Kathleenoffenholley@yahoo.com) (or [koffenholley@bmcc.cuny.edu](mailto:koffenholley@bmcc.cuny.edu))

Links to the games:

<https://mathgamesforstem.wordpress.com/>

Blog about math games, with non-digital games you can play: <https://mathgames.common.gc.cuny.edu/>

# A Multi-tiered Approach to Undergraduate Science Learning in an Urban Public College

Sandra Swenson & Yi He  
John Jay College, CUNY

DUE Division Of Undergraduate Education  
EHR Direct For Education and Human Resources  
NSF TUES DUE\_1245314 CHEMISTRY EDUCATION  
December 1, 2013 and expires November 30, 2015.



# Description of Proposal & Award

- **MAIN PROJECT GOAL:**

- To create, implement and evaluate curricula that connect STEM, the environment and civic responsibility.

- **HOW WILL THE GOAL BE ACCOMPLISHED?** See Blooms Taxonomy & Wiggins and McTighe Understanding By Design

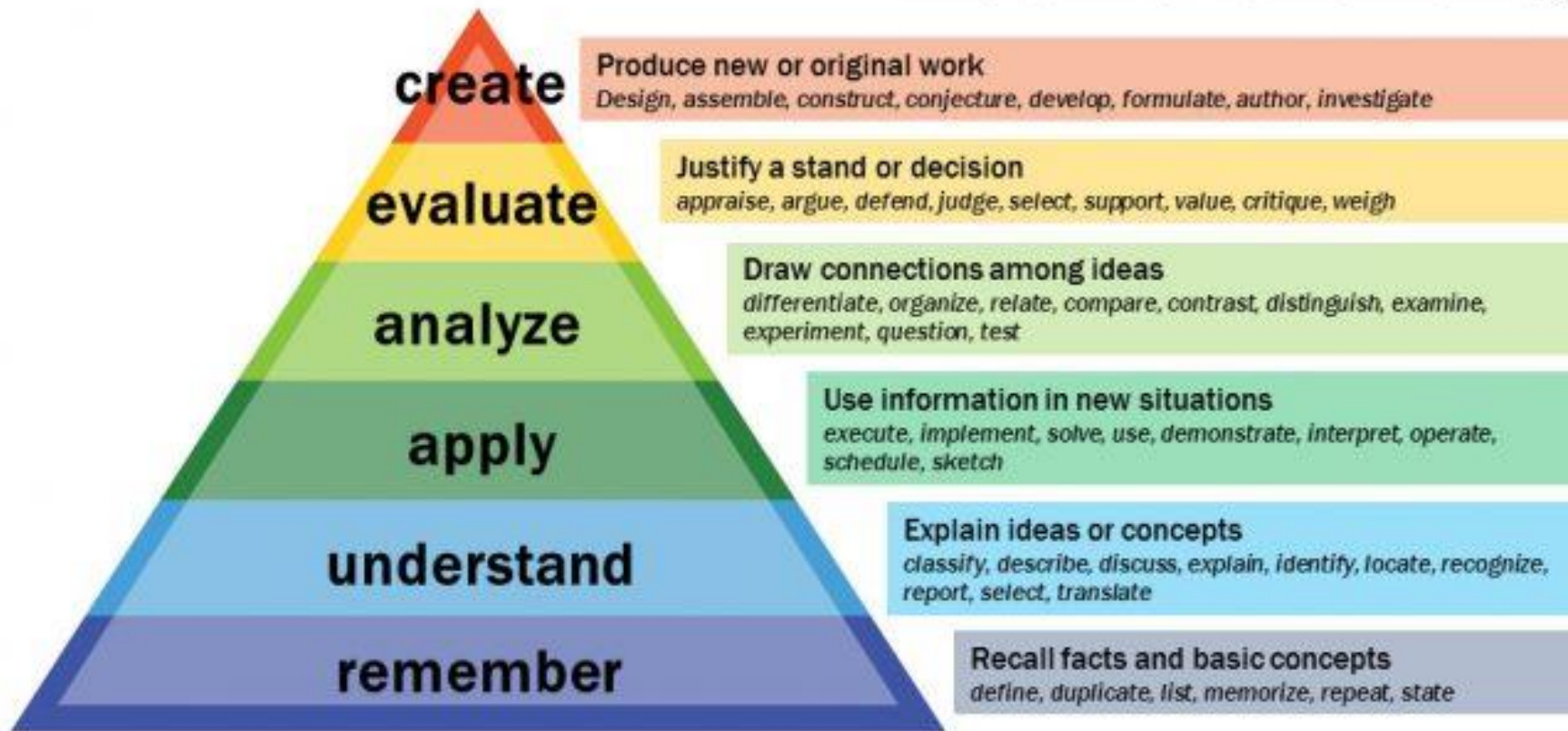
- Students will be actively engaged in...
- Development of collaborative learning skills... (or any skill)
- What conceptual understandings do you want to foster? How will they be fostered?
- What kind of new technology do you want students to learn about? How will they learn it?

•

# Blooms Taxonomy

<http://www.bloomstaxonomy.org/Blooms%20Taxonomy%20questions.pdf>

## Bloom's Taxonomy



Vanderbilt University Center  
for Teaching



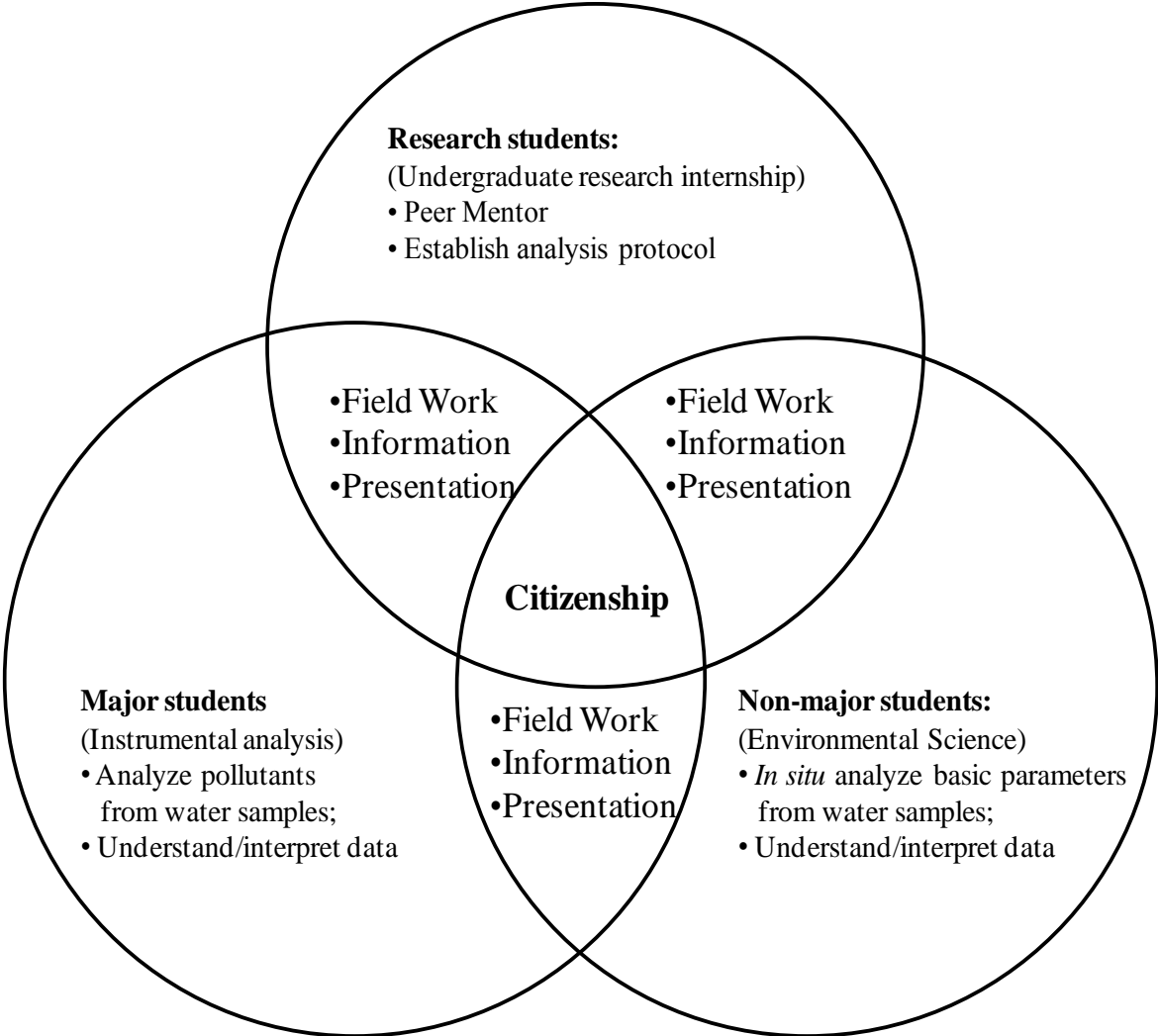
# Grant Wiggins and Jay McTighe, Understanding by Design, 2005

- Backward Design: Effective curriculum is planned backward from long-term, desired results through a three-stage design process (Desired Results, Evidence, and Learning Plan);
- The Understanding by Design framework is guided by the confluence of evidence from two streams—theoretical research in cognitive psychology, and results of student achievement studies. A summary of the key research that undergirds UbD framework can be found at [www.ascd.org](http://www.ascd.org) under Research A Topic.

# What the students will be doing and learning

- These students work together to collect, analyze, interpret, and report out on data that have been collected from the Superfund sites.
- Student learning objectives that are being evaluated as part of the project include:
  - development of collaborative learning skills that help students understand how to communicate their ideas and how shared responsibilities play important roles in science;
  - and student understanding of the process of science, including how scientists reason with data.

# Diagrams are important for elucidating ideas:



# Your research will benefit a larger audience...

- The curriculum and instruction being developed is a working model for colleges and universities, including five current partner community colleges in the NY City area, who are interested in bridging the gap between research scientists and science-informed citizens.

# Research area:

- Research included designing new curriculum that was used as a part of an intervention study;
- qualitative research on collaborative learning between non-science majors and science majors;
- an assessment of motivation of undergraduate science student;
- an evaluation of how well students communicate about data that they've collected in the field and from internet-based sources.

# Why I was interested in the EHR Program

- My professional career path is in science education but I wanted to collaborate with a scientist on this project so that we could draw from each others' strength.
- In the same respect, I wanted my liberal arts students to collaborate with science students so that they could learn from each other.





Liberal Arts students demonstrating to the Analytical Chemistry students how to use the water samplers as well as the Vernier® probes for testing salinity, pH, and temperature.



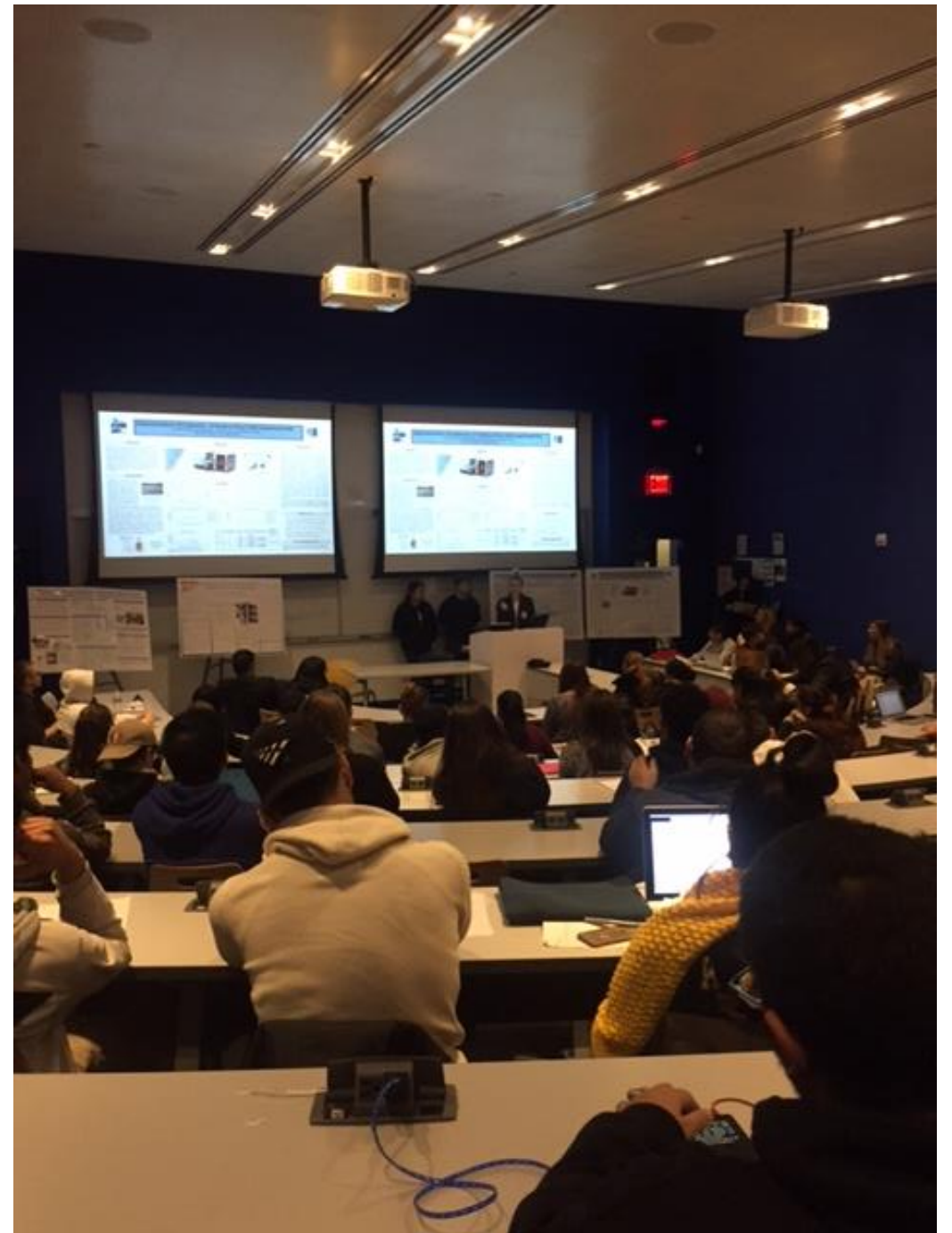
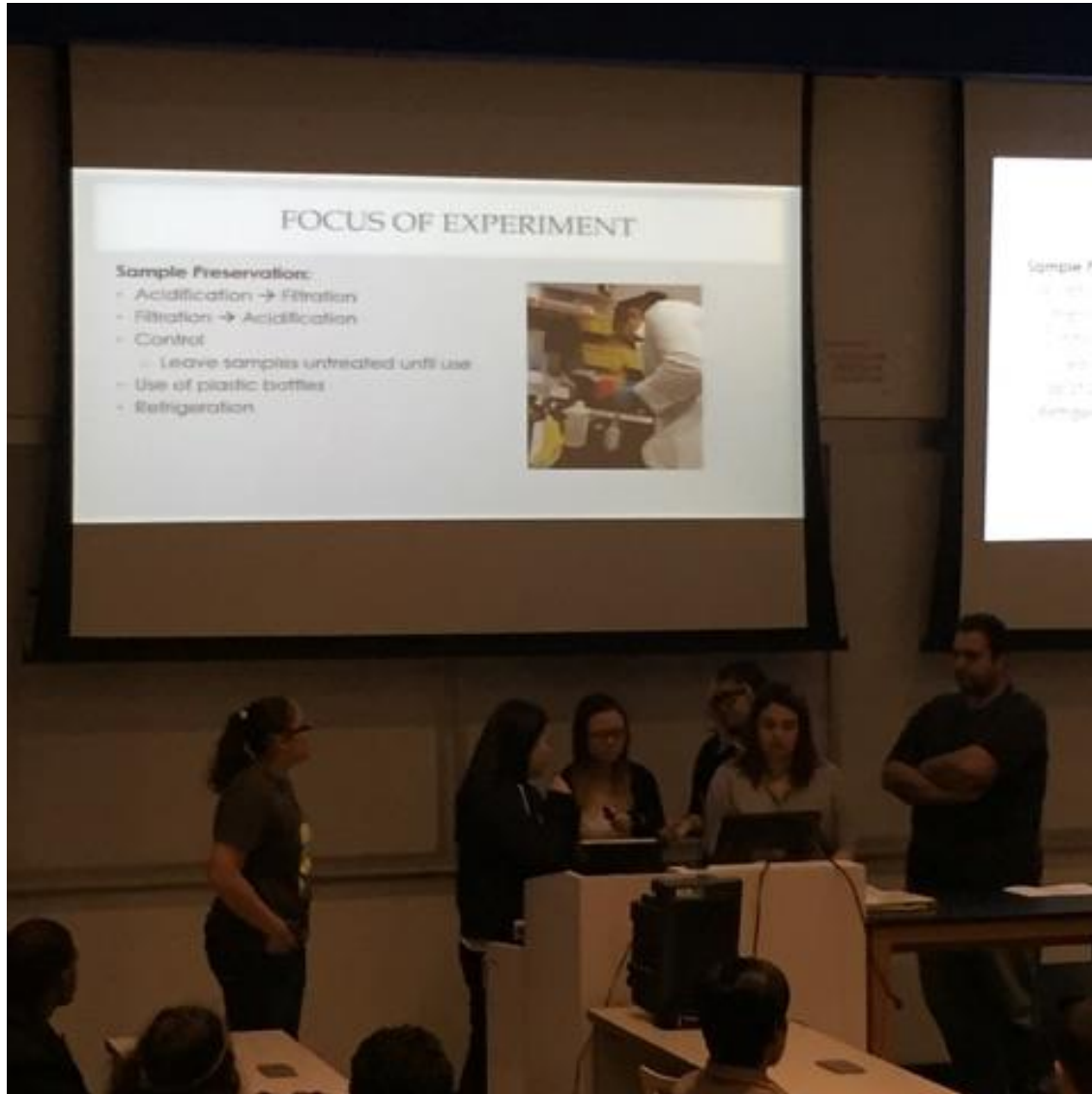
Instrumental Analysis  
students collected water  
samples to begin calibration  
on their instruments testing  
for cadmium and PCBs.



# In the Instrumental Analysis lab



# End of the semester presentations:



# Consultations and Collaborations

- Thomas J. Wenzel, PhD; Chair, Department of Chemistry, Bates College Lewiston, ME
  - Has written many articles on collaborative learning in the analytical chemistry classroom.
- Gregory O'Mullan, PhD; Assistant Professor and Graduate Advisor, School of Earth and Environmental Science, Queens College, CUNY
  - Extensive background in water quality testing; works closely with the Hudson Riverkeeper Project; helped us to establish instrumentation for testing enterococcus bacteria.
- Andrew Goodwillie, PhD; Research Scientist, Lamont Doherty Earth Observatory, Columbia University
  - Expertise in mapping data using GeoMapApp.

# Transformative and Innovative Aspects

- Our grant ended in 2016 (we were given a 9 month extension);
- Dr. He and I redesigned our laboratory curriculum based on the feedback from the student surveys and interviews;
- I've scaled up the new lab curriculum to all classes in the Environmental Science laboratory (liberal arts students); all students are now doing field work.
- We continue to bring some collaborative aspects into our laboratory and lecture class; Instrumental Analysis research students come into the Env. Sci. labs to present their findings on PCBs and cadmium.

# Leveraging EHR Funding to Obtain Additional Support

- When designing your grant be sure that it includes:
  - Scalability;
  - Projected avenues for professional outreach within a University system;
  - Projected avenues for professional outreach nationwide;
  - Intent to present at national science symposiums;
  - Intent to publish journal articles.

# Tips to CUNY on Making EHR Proposals Competitive and Successful

- Student centered;
- Have a succinct goal with objectives that articulate how students will benefit;
- Have a strong evaluation plan- use a professional evaluator;
- Invite mentors who have published in your area of interest to be your advisors;
- Have a solid time-line;
- Use flow charts and diagrams when appropriate.



# **Workshop on NSF Education and Human Resources (EHR) Programs**

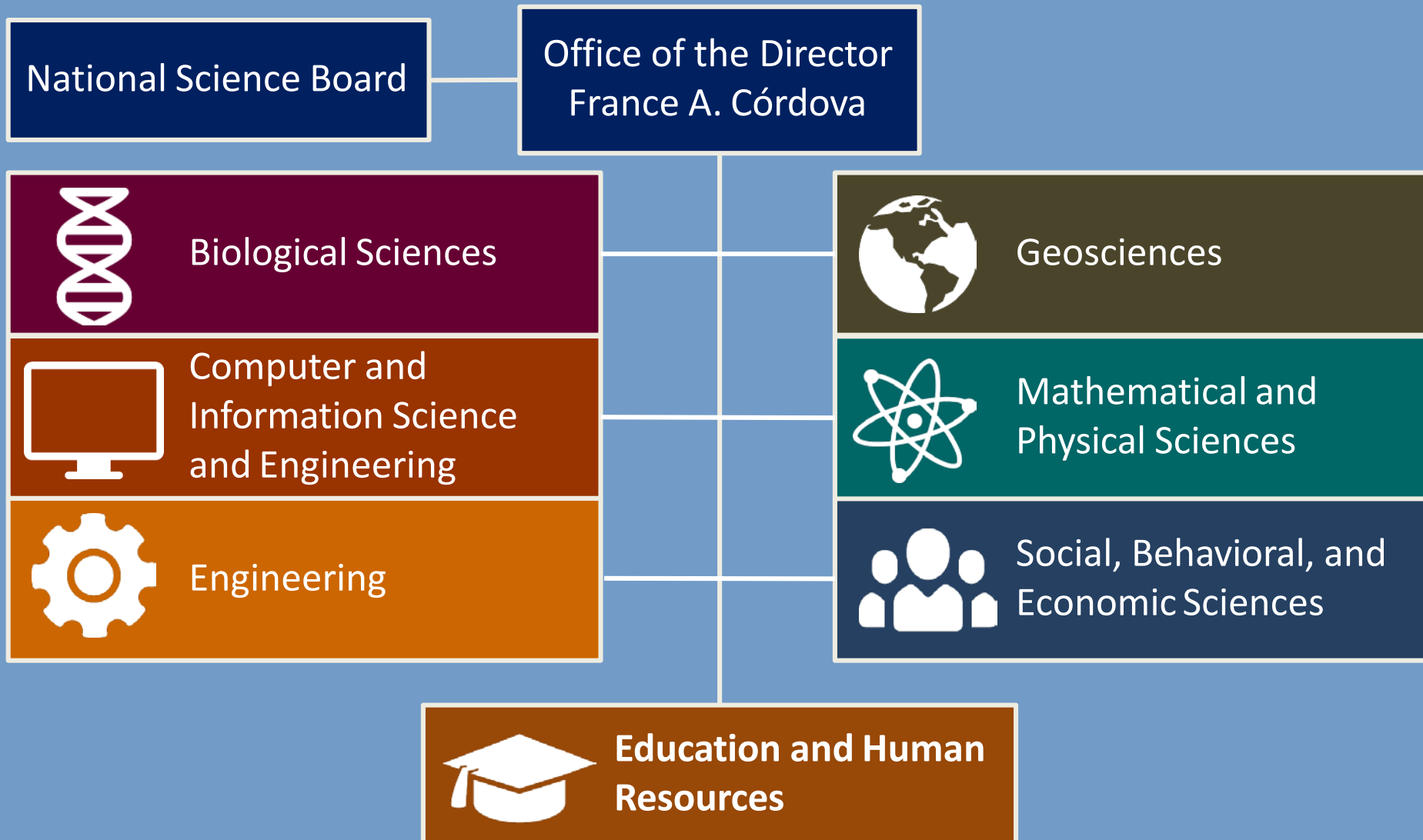
**May 17, 2017**

**John Tsapogas**

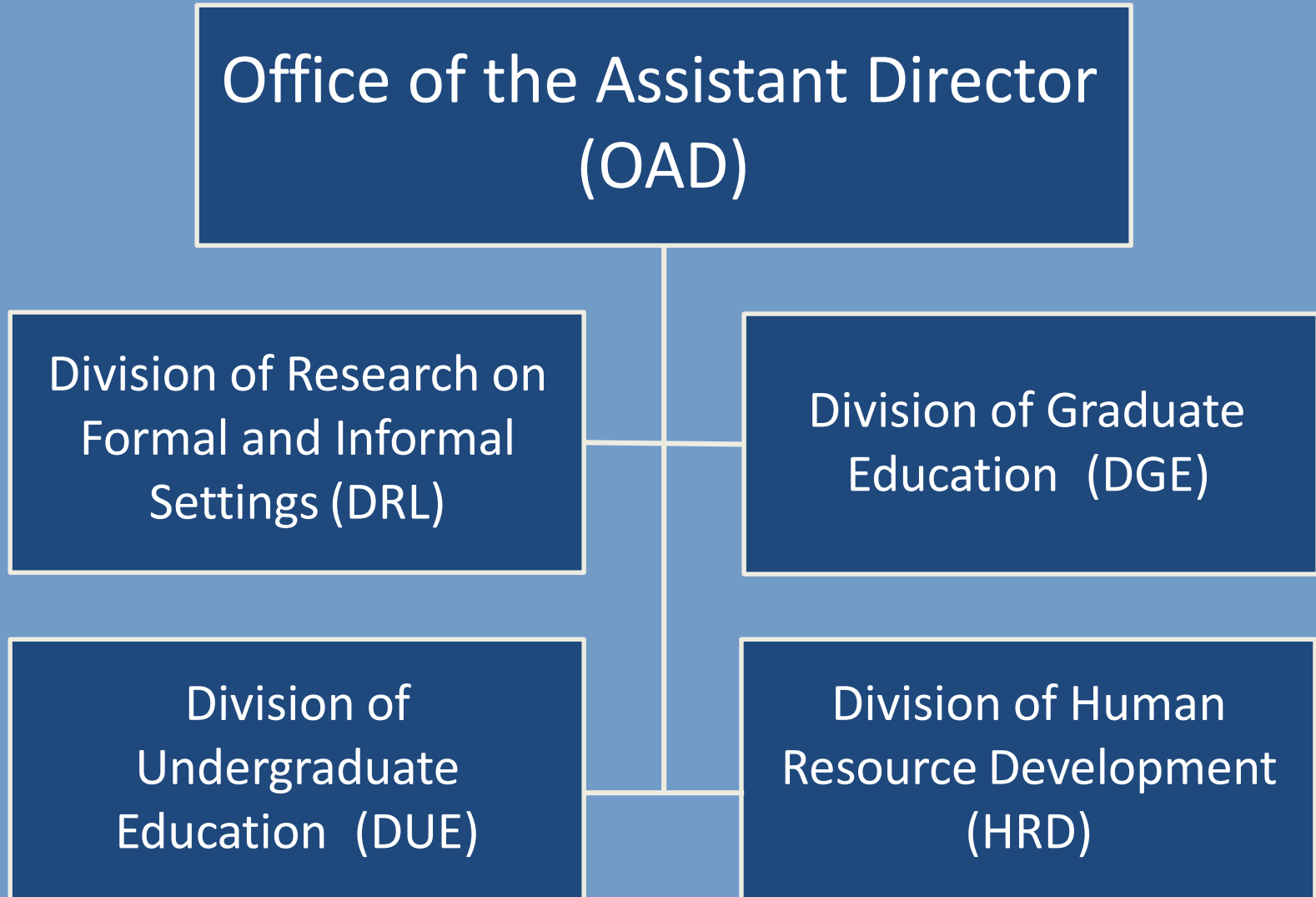
**Director, Award Pre-Proposal Support**

**Research Foundation of the City University of New York**

# The National Science Foundation



# EHR's organizational structure



# Data on EHR Activities

**\$953**

million  
FY 2017  
request



**4,243**  
proposals



**831**  
awards funded



**650**  
EHR-funded  
Institutions



**147,000**  
EHR-supported  
researchers



Funds all S&E  
disciplines



Funds  
research in  
STEM  
education



42 former  
GRF fellows  
received  
Nobel Prize

# Federal STEM Education 5-Year Strategic Plan

## **P-12 STEM Education**

**100,000 new K-12 STEM teachers by 2020 and support existing STEM teacher workforce**

## **Undergraduate Education**

**Graduate 1 million additional students with degrees in STEM fields over a decade**

## **Graduate Education**

**Provide basic research expertise, professional development, and specialized skills development to graduate-trained STEM professionals**

## **Broadening Participation**

**Increase number of underrepresented minorities graduating in STEM and improve women's participation where they are significantly underrepresented**

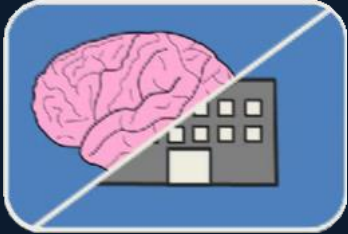
## **Youth & Public Engagement**

**Support a 50% increase in the number of youth who have authentic STEM experiences each year**

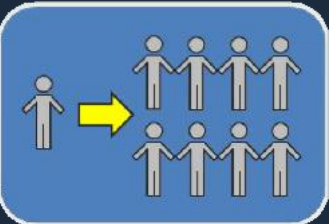
## **Governance & Coordination**

**Build new models for leveraging assets and expertise  
Build and use evidence-based approaches**

# EHR's Focal Areas



*Learning & Learning Environments*



*Broadening Participation & Institutional Capacity*



*Workforce Development*

# Goals of NSF Education and Human Resources Programs

Prepare the **next generation of STEM professionals** and attract and retain more Americans to STEM careers.

Develop a robust research community that can conduct **rigorous research and evaluation** that will support excellence in STEM education and that **integrates research and education**.

Increase **the technological, scientific and quantitative literacy** of all Americans so that they can exercise responsible citizenship and live productive lives in an increasingly technological society.

Broaden participation (**individuals, geographic regions, types of institutions, STEM disciplines**) and close achievement gaps in all STEM fields.

# Program Focus in the EHR Directorate

EHR Division	Learning and Learning Environments	Broadening Participation in STEM	STEM Professional Workforce
Research on Learning (DRL)	ECR - <i>Learning</i> DR-PK12 AISL	ECR includes: • Research on Gender in Science and Engineering (GSE) • Research in Disabilities Education (RDE)	<ul style="list-style-type: none"> <li>• STEM+C Partnerships for the 21<sup>st</sup> Century</li> <li>• ITEST - Innovative Technology Experiences for Students and Teachers</li> <li>• CSforAll</li> <li>• ITEST</li> </ul>
Graduate Education (DGE)	Project and Program Evaluation (PPE) Building Community & Capacity in Data (BCC)	ECR- <i>STEM Professional Workforce</i> CyberCorps: Scholarship for Service (SFS) Graduate Research Fellowship (GRF) National Research Traineeship (NRT)	
Human Resource Development (HRD)	ADVANCE AGEP HBCU-UP TCUP	ECR- <i>Broadening Participation and Capacity Building</i> LSAMP	Excellence Awards in Science and Engineering - PAEMST & PAESMEM CREST
Undergraduate Education (DUE)	ECR- <i>Learning Environment</i> Improving Undergraduate STEM Education (IUSE)		Advanced Technological Education (ATE) Robert Noyce Teacher Scholarship Program S-STEM Scholarship Program



# Program Focus in DRL

EHR Division	Learning and Learning Environments	Broadening Participation in STEM	STEM Professional Workforce
<p>Research on Learning in Formal and Informal Settings (DRL)</p>	<p>Core Research &amp; Development (ECR)</p> <p>DR-K12- (Discovery Research K-12 )</p> <p>AISL- Advancing Informal STEM Learning</p> <p>Big Data</p>	<p>ECR* includes:</p> <ul style="list-style-type: none"> <li>• Research on Gender in Science and Engineering (GSE)</li> <li>• Research in Disabilities Education (RDE)</li> <li>• AISL and ITEST are BP emphasis programs</li> </ul>	<p>STEM+C</p> <p>Partnerships for the 21<sup>st</sup> Century</p> <p>ITEST - Innovative Technology Experiences for Students and Teachers</p> <p>CSforAll</p>

# Program Focus in DGE

<b>EHR Division</b>	<b>Learning and Learning Environments</b>	<b>Broadening Participation in STEM</b>	<b>STEM Professional Workforce</b>
<b>Graduate Education (DGE)</b>	<b>Project and Program Evaluation (PPE)/Promoting Research and Innovation in Methodologies for Evaluation (PRIME)</b>	<ul style="list-style-type: none"><li>• <b>EHR Core Research: Workforce Development (ECR)*</b></li><li>• <b>SFS- CyberCorps: Scholarship for Service</b></li><li>• <b>GRF - Graduate Research Fellowship</b></li><li>• <b>NRT- National Research Traineeship</b></li><li>• <b>NSF Innovation Corps (I-Corps)</b></li></ul>	

# Program Focus in HRD

EHR Division	Learning and Learning Environments	Broadening Participation in STEM	STEM Professional Workforce
<b>Human Resource Development (HRD)</b>	<ul style="list-style-type: none"> <li>• <b>ADVANCE</b>-Increasing the Participation and Advancement of Women in S &amp; E careers</li> <li>• <b>AGEP</b>-Alliances for Graduate Education and the Professoriate</li> <li>• <b>HBCU-UP</b>-Historically Black Colleges and Universities Undergraduate Program</li> <li>• <b>TCUP</b>- Tribal Colleges and Universities Programs</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Core Research &amp; Development (ECR)</b></li> <li>• <b>LSAMP</b>- Louis Stokes Alliances for Minority Participation</li> </ul>	<ul style="list-style-type: none"> <li>• <b>PAEMST</b>- Presidential Awards for Excellence in Mathematics and Science Teaching</li> <li>• <b>PAESMEM</b>- Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring)</li> <li>• <b>CREST</b>- Centers of Research Excellence in Science and Technology</li> </ul>

# Program Focus in DUE

<b>EHR Division</b>	<b>Learning and Learning Environments</b>		<b>STEM Professional Workforce</b>
<b>Undergraduate Education (DUE)</b>	<b>Core Research &amp; Development (ECR)</b>  <b>IUSE- Improving Undergraduate STEM Education</b>		<b>Advanced Technological Education (ATE)</b>  <b>Robert Noyce Teacher Scholarship Program (NOYCE)</b>  <b>S-STEM = Scholarship in STEM Program</b>

# Research and Evaluation

- All EHR awards are expected to contribute to knowledge about STEM learning and learning environments, workforce development or broadening participation.
- Research
  - Is integral to the project
  - Contributes to generalizable knowledge
  - Depending on the research questions, can be qualitative, quantitative or mixed
- Evaluation
  - All projects must have a way to assess process or outcomes
  - Depending on the solicitation, evaluation needs to be independent but can be done by an external firm, an advisory board or through peer review

# NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)

Increases the number of low-income academically talented students with demonstrated financial need obtaining degrees in STEM and entering the workforce or graduate programs in STEM

Improve the education of future scientists, engineers, and technicians, with a focus on academically talented low-income students; and

Generate knowledge to advance understanding of how factors or evidence-based curricular and co-curricular activities affect the success, retention, transfer, academic/career pathways, and graduation in STEM of low-income students.

# NSF Advanced Technological Education (ATE) Program

Emphasis on two-year colleges.

Focuses on the education of technicians for the high-technology fields that drive our nation's economy.

Partnerships between academic institutions and industry to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels.

Supports curriculum development; professional development of college faculty and secondary school teachers; career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions.

Also supports articulation between two-year and four-year programs for K-12 prospective STEM teachers that focus on technological education.

# NSF-Improving Undergraduate STEM Education (IUSE) Program

Educating students to be leaders and innovators in emerging and rapidly changing STEM fields

Educating a scientifically literate populace

Investing in evidence-based and evidence-generating approaches to understanding STEM learning

Designing, testing, and studying instruction and curricular change

Wide dissemination and implementation of best practices



# NSF-Innovative Technology Experiences for Students and Teachers (ITEST) Program

Supports the development, implementation, and selective spread of innovative strategies for engaging students in experiences that:

- (1) Increase student awareness of STEM and ICT careers;
- (2) Motivate students to pursue the education necessary to participate in those careers; and/or
- (3) Provide students with technology-rich experiences that develop their knowledge of related content and skills (including critical thinking skills) needed for entering the STEM workforce.

ITEST projects must involve students, and may also include teachers. The ITEST program is especially interested in broadening participation of students from traditionally underrepresented groups in STEM fields and related education and workforce domains.

Projects that actively engage business and industry partners to better ensure that PreK-12 experiences foster the knowledge and skill-sets needed for emerging STEM-related occupations are strongly encouraged.

# NSF-Louis Stokes Alliances for Minority Participation (LSAMP)

Assists universities and colleges in their efforts to significantly increase the numbers of students matriculating into and successfully completing high quality degree programs in science, technology, engineering and mathematics (STEM) disciplines in order to diversify the STEM workforce.

Particular emphasis is placed on transforming undergraduate STEM education through innovative, evidence-based recruitment and retention strategies, and relevant educational experiences in support of racial and ethnic groups historically underrepresented in STEM disciplines.

African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, and Native Pacific Islanders.

# Research Experiences for Undergraduates

Effective avenue for attracting students to and retaining them in science and engineering

Preparing them for careers in these fields

Sites and Supplements

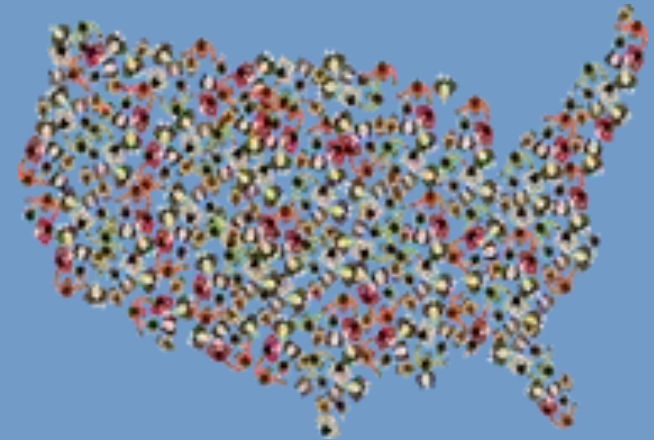
Provides appropriate and valuable educational experiences for undergraduate students through participation in research.

High-quality interaction of students with faculty and/or other research mentors and access to appropriate facilities and professional development opportunities.

# NSF INCLUDES (17-522)

Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

FY 2016: NSF 16-544, 16-081, \$15.5M  
FY 2017 Budget Request \$16M



- Comprehensive initiative to enhance U.S. leadership in science and engineering by seeking and developing STEM talent from all sectors and groups in our society
- Long-term goal  
*Support innovative models, networks, partnerships, and research that enable the U.S. science and engineering workforce to thrive by ensuring that all groups are represented in percentages comparable to their representation in the U.S. population*

# Using Collective Impact\*- style approaches to scaling social innovation



# NSF INCLUDES National Network

	FY16	FY17	FY18 and beyond
<b>Design and Development Launch Pilots</b>	2 year awards @ \$300K (30-40 awards)	2 year awards @ \$300K	2 year awards @ \$300K
<b>Alliances</b> may be funded in FY 17		5 year awards @ \$12.5M (3-5 awards)	5 year awards @ \$12.5M
<b>Backbone Organizations</b> may be funded in 17	Conferences and Workshops	5 year award(s) @ \$3.5M	5 year awards @ \$3.5M
<b>Other Activities</b>	PI Meeting Evaluation & Assessment	Link to BP Portfolio Evaluation & Assessment	Link to BP Portfolio Evaluation & Assessment

# Key elements INCLUDES is looking for

Design & Development  
Launch Pilots in FY16, FY17



**Novel systems approaches and collective impact-style strategies**



**New research, models, networks, and partnerships to scale social innovations**



**Leverage the current Broadening Participation Portfolio**



**Collaborative alliances spanning education levels, public and private sectors**

# Engage with NSF

- Submit Proposals
- Serve as Reviewers & Panelists
- Be Active as Workshop Participants and Organizers
- Consider Being a Rotator

[http://www.nsf.gov/about/career\\_opps/rotators/index.jsp](http://www.nsf.gov/about/career_opps/rotators/index.jsp)



For information on a particular EHR division and program, go to the EHR website and choose a division.

<http://www.nsf.gov/dir/index.jsp?org=EHR>

**Contact NSF Program Directors for questions and suggestions**



# Stay connected

- NSF: [www.nsf.gov](http://www.nsf.gov)
- Proposal and Award Policies and Procedures Guide (PAPPG):  
<http://>
- Guide to Programs:  
[www.nsf.gov/funding/browse\\_all\\_funding.jsp](http://www.nsf.gov/funding/browse_all_funding.jsp)
- Award Information: [www.nsf.gov/awardsearch](http://www.nsf.gov/awardsearch)
- FastLane: [www.fastlane.nsf.gov](http://www.fastlane.nsf.gov)
- Broader Impacts: [www.nsf.gov/pubs/gpg/broaderimpacts.pdf](http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf)
- Data Management Plan: [www.nsf.gov/bfa/dias/policy/dmp.jsp](http://www.nsf.gov/bfa/dias/policy/dmp.jsp)
- Funding Opportunities: [www.nsf.gov/funding](http://www.nsf.gov/funding)

# Thank You!

[John\\_Tsapogas@rfcunyny.org](mailto:John_Tsapogas@rfcunyny.org)