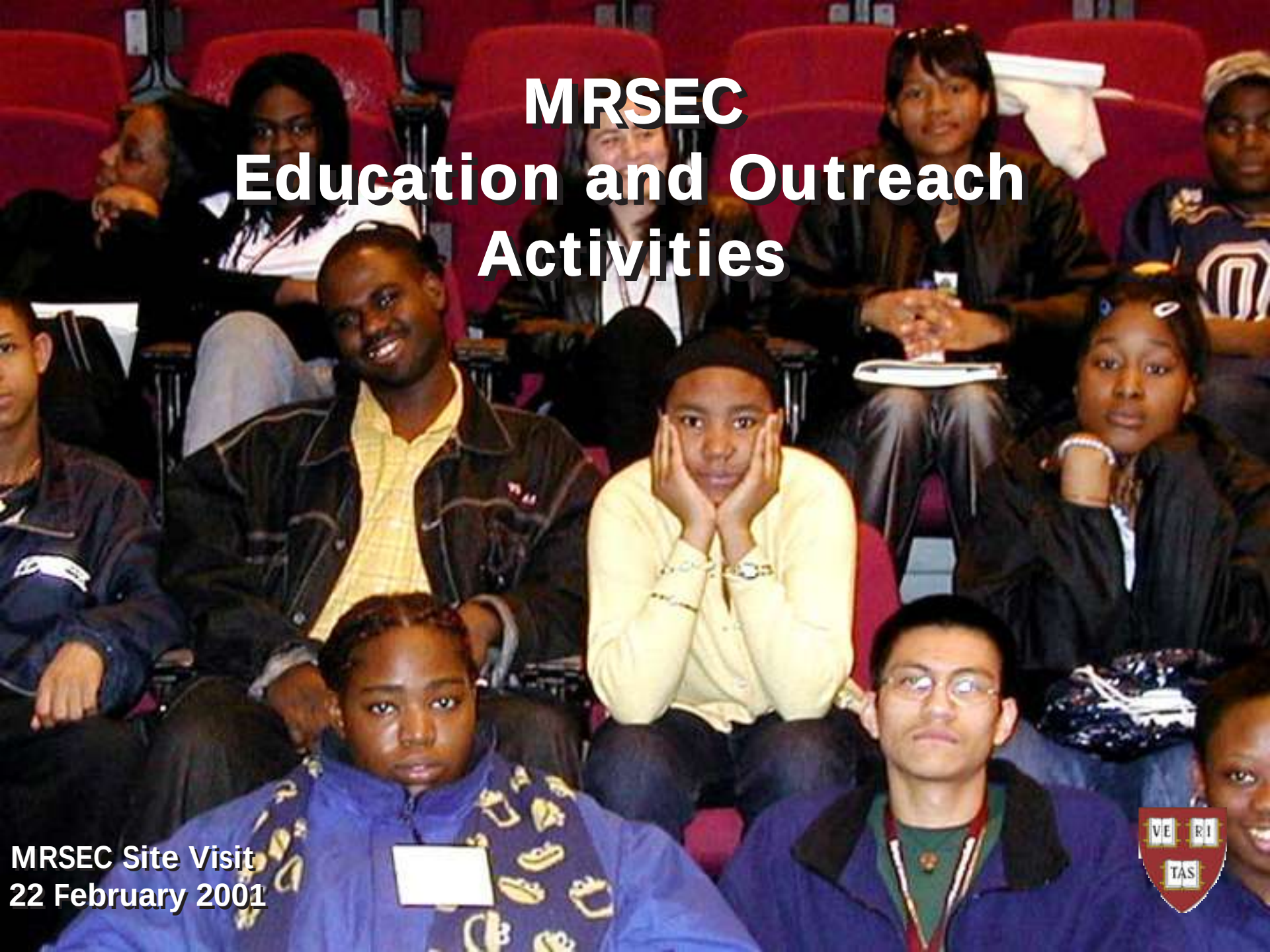

MRSEC
Education and Outreach
Activities
MRSEC Site Visit
22 February 2001
VE RI
TAS

Overview

- **K-12 students**

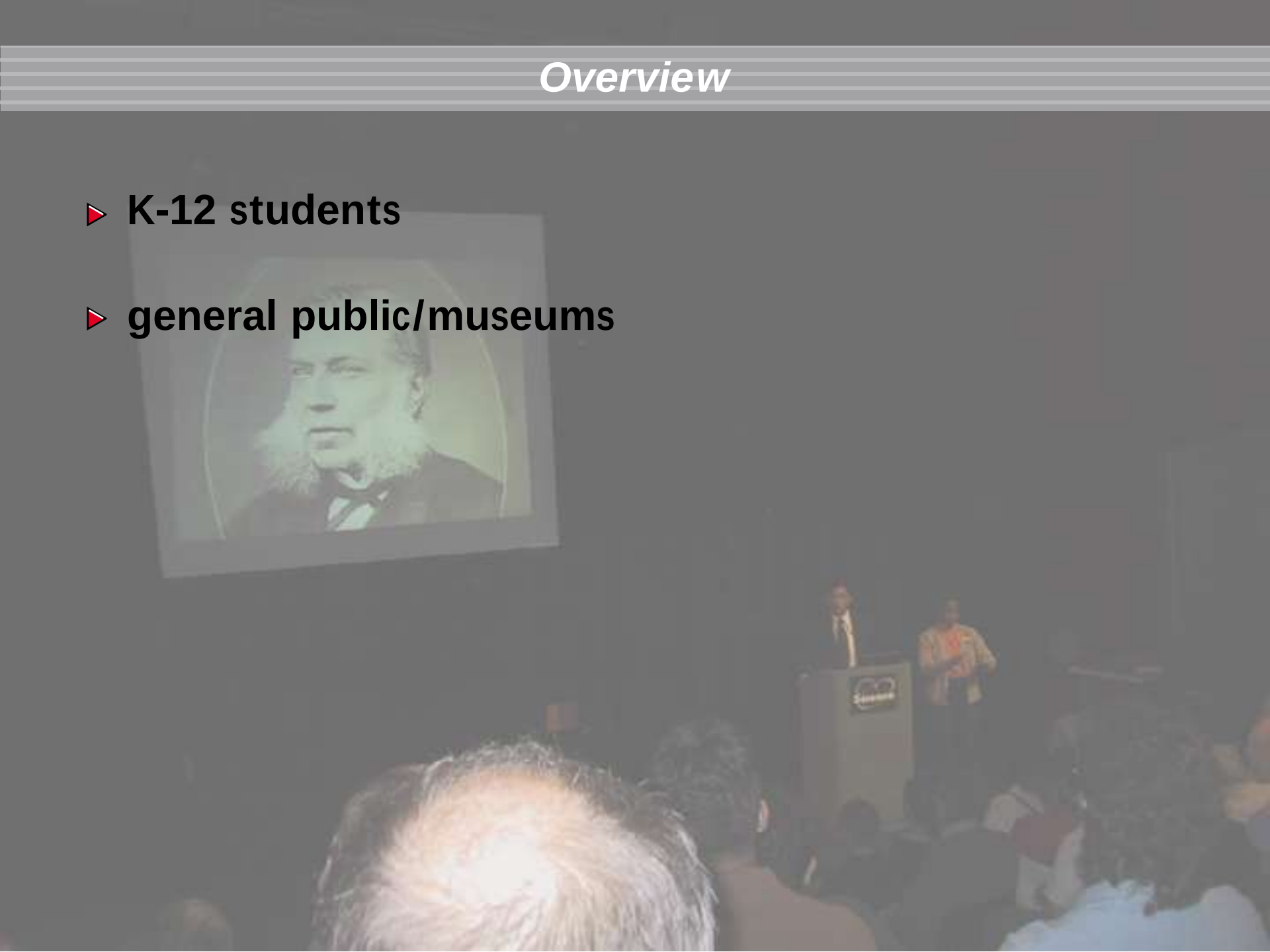
Overview

- **K-12 students**

Project TEACH	Cambridge Public Schools	500 students
School visit	Taft Middle School, MA	200 students
School visit	Kipp Academy, TX	75 students
School visit	Hopi High School, AZ	24 students
Science Academy	Local Public High Schools	12 students
Science Fair Judging	Lexington Middle and High schools	40 students

Overview

- **K-12 students**
- **general public/museums**

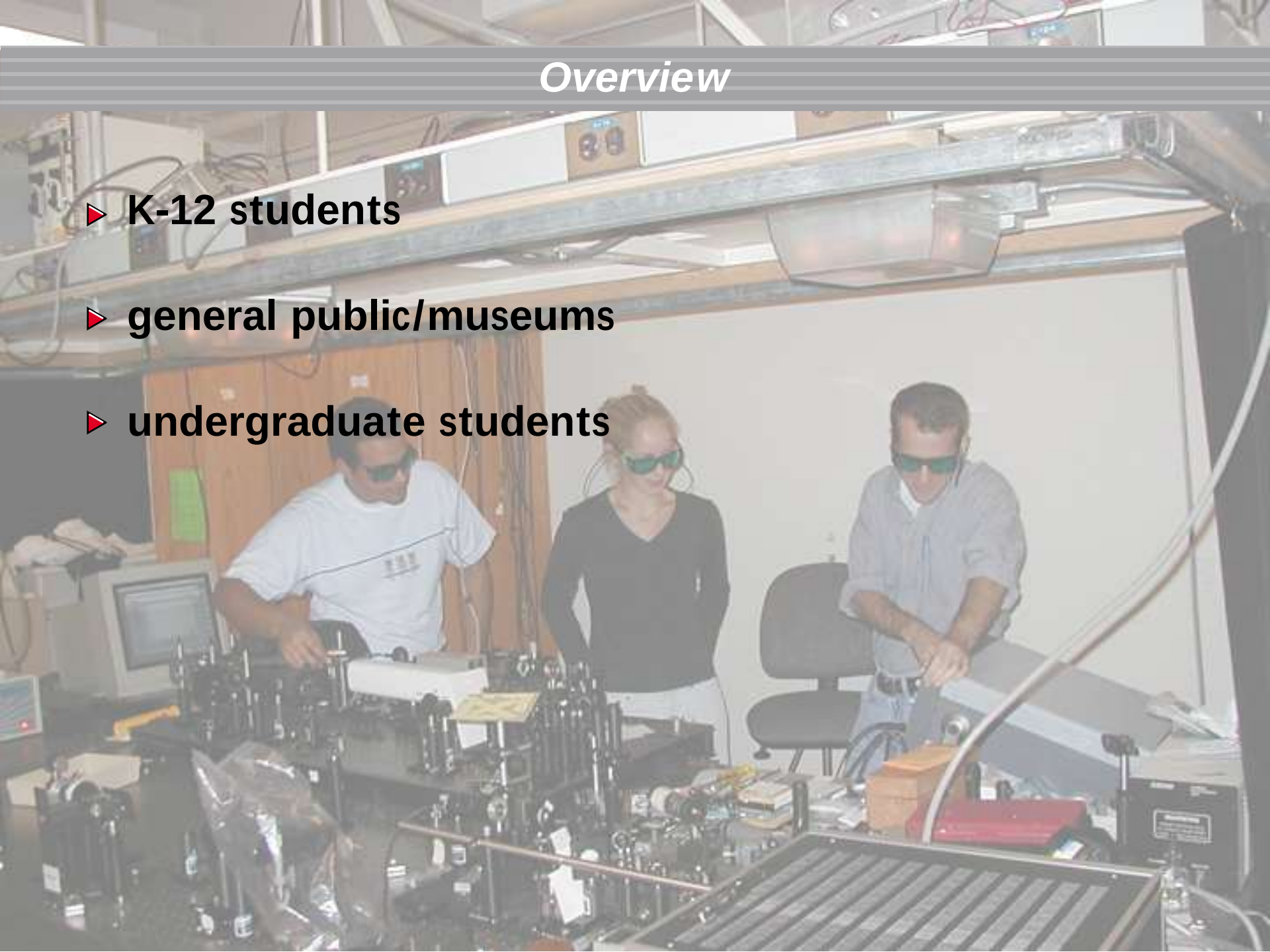


Overview

- **K-12 students**
- **general public/museums**

Public lecture	**Museum of Science/Mazur**	**150 people**
Public lecture	**Science Center/Heller**	**200 people**
Public lecture	**Science Center/Stone**	**200 people**
Public lecture	**University of Puerto Rico/Mazur**	**next week!**

Overview



- K-12 students
- general public/museums
- undergraduate students

Overview

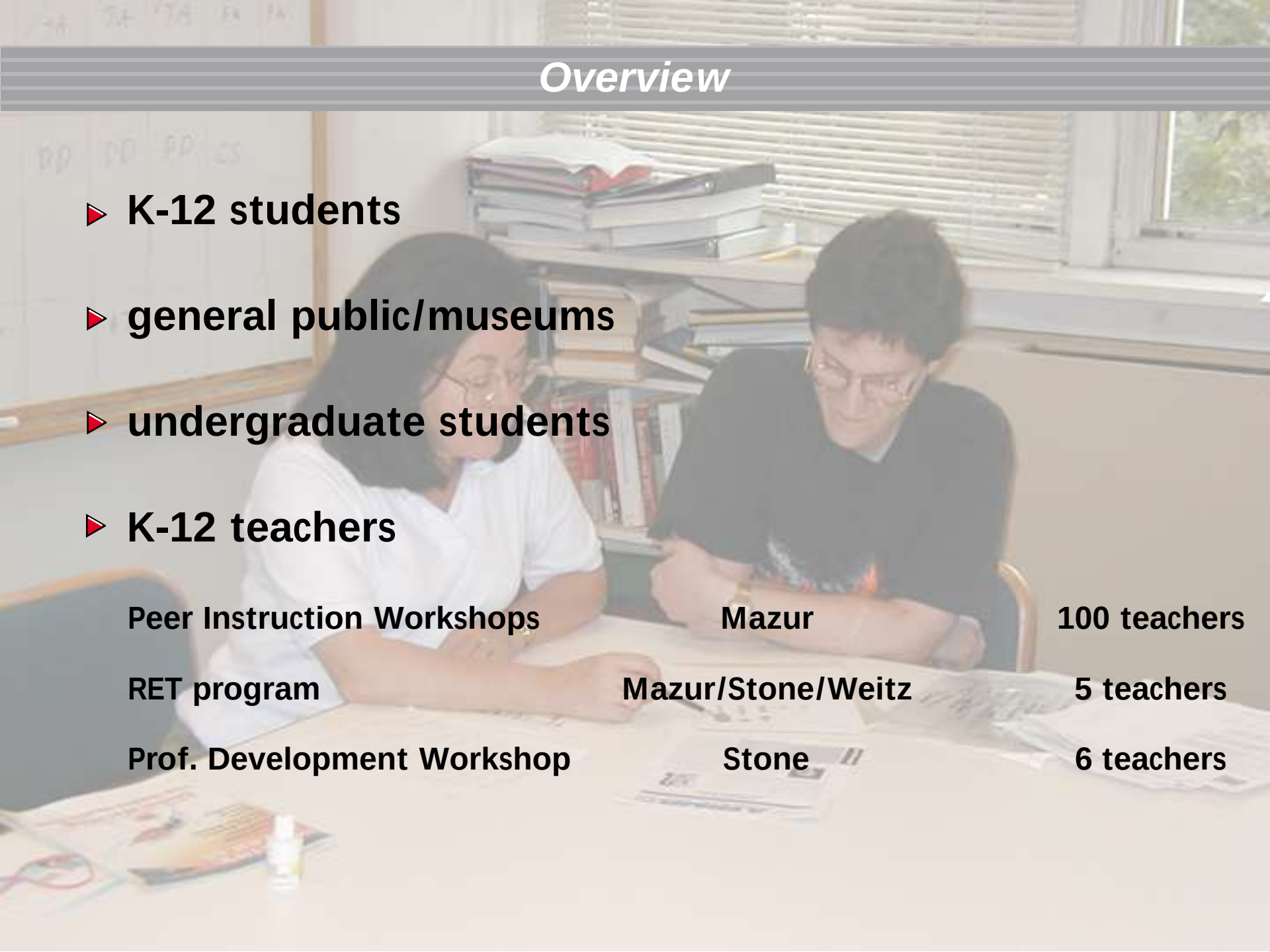
- K-12 students
- general public/museums
- undergraduate students

REU program	various colleges & universities	20/year
Freshman Seminar	freshman	10/year
Core courses	non-science majors	200/year
Research courses	science majors	10/year
Industrial internship	science majors	2/year

Overview

- **K-12 students**
- **general public/museums**
- **undergraduate students**
- **K-12 teachers**

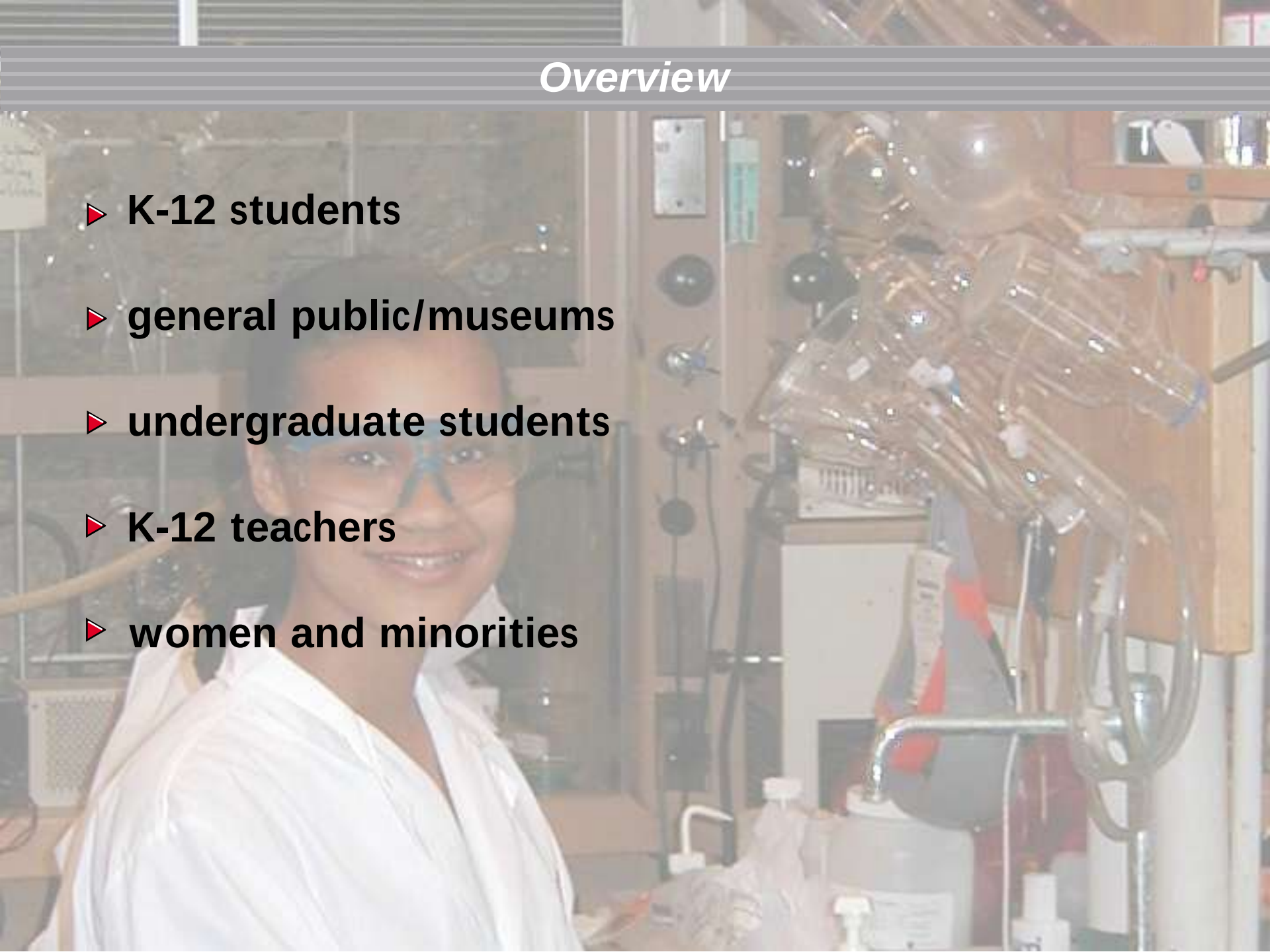
Overview



- **K-12 students**
- **general public/museums**
- **undergraduate students**
- **K-12 teachers**

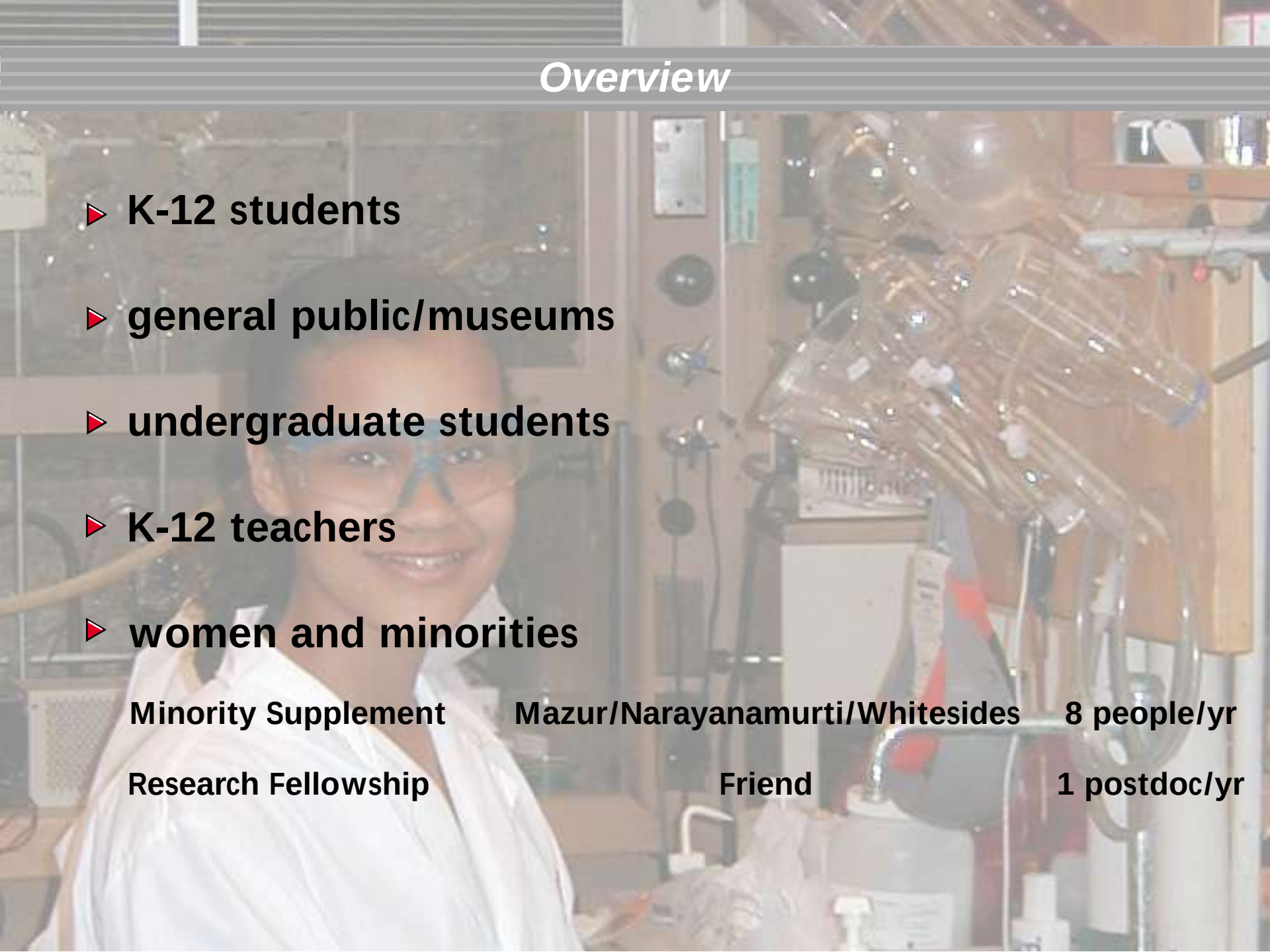
Peer Instruction Workshops	**Mazur**	**100 teachers**
RET program	**Mazur/Stone/Weitz**	**5 teachers**
Prof. Development Workshop	**Stone**	**6 teachers**

Overview



- K-12 students
- general public/museums
- undergraduate students
- K-12 teachers
- women and minorities

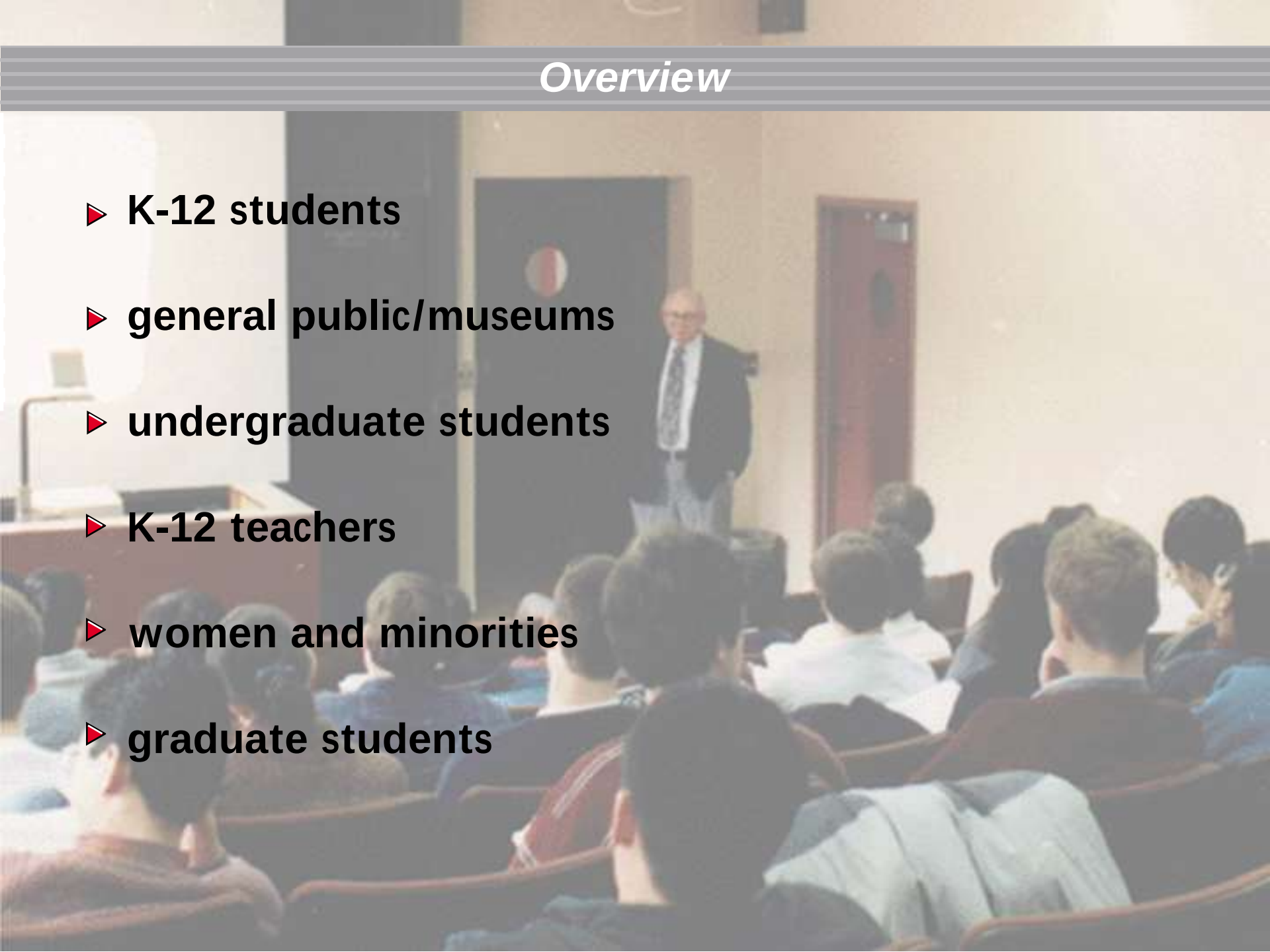
Overview



- **K-12 students**
- **general public/museums**
- **undergraduate students**
- **K-12 teachers**
- **women and minorities**

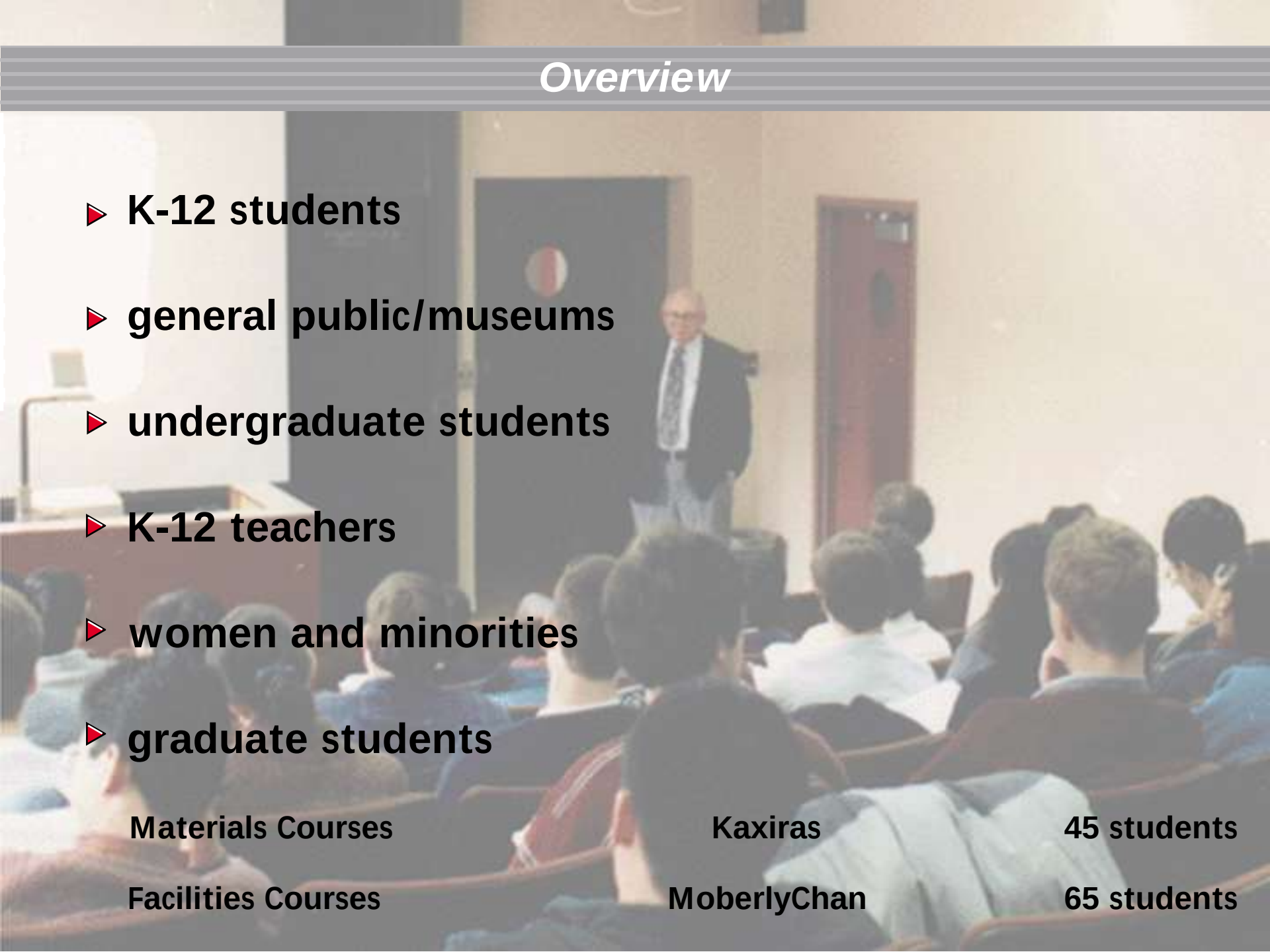
Minority Supplement	**Mazur/Narayanamurti/Whitesides**	**8 people/yr**
Research Fellowship	**Friend**	**1 postdoc/yr**

Overview



- K-12 students
- general public/museums
- undergraduate students
- K-12 teachers
- women and minorities
- graduate students

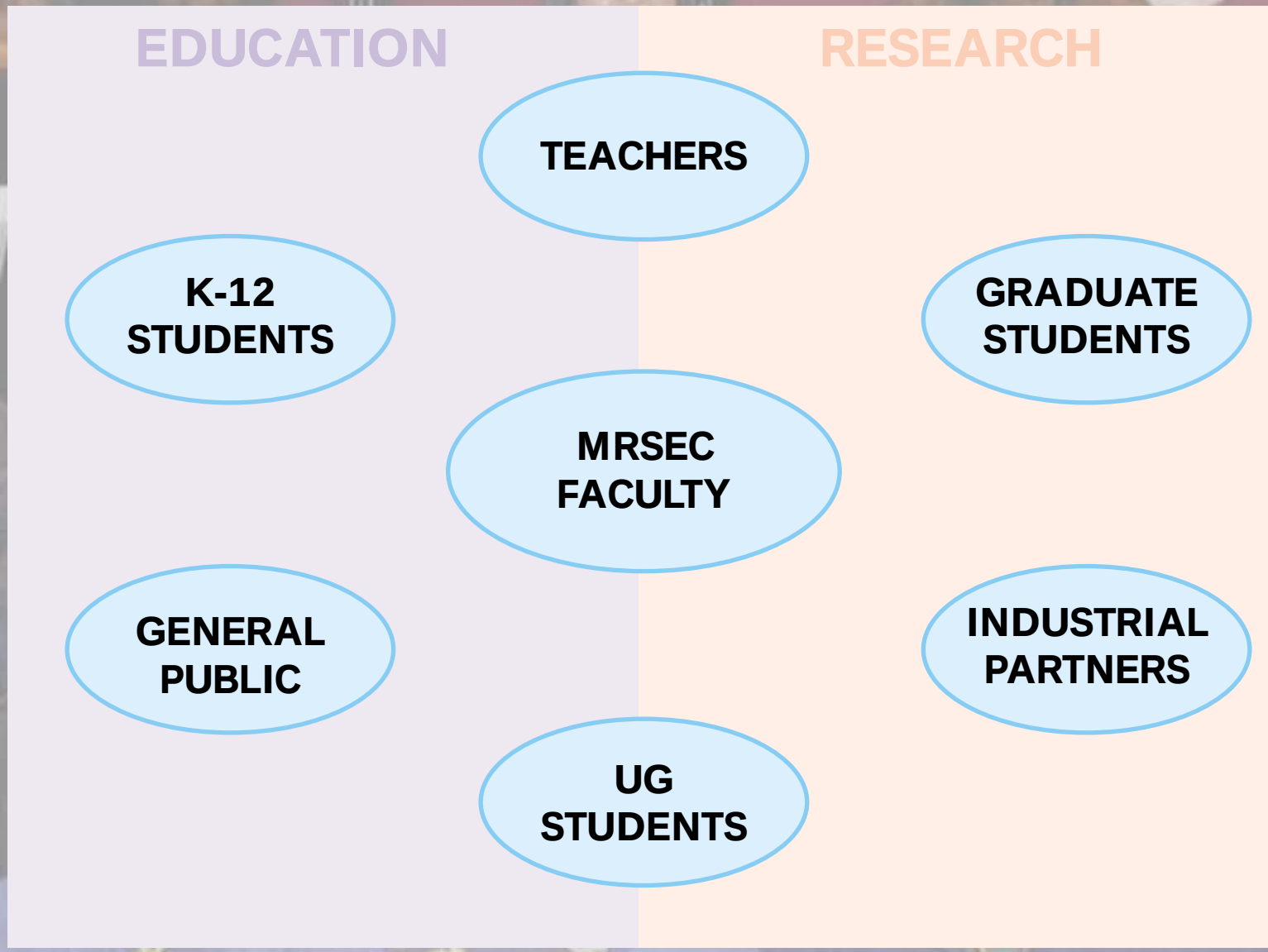
Overview



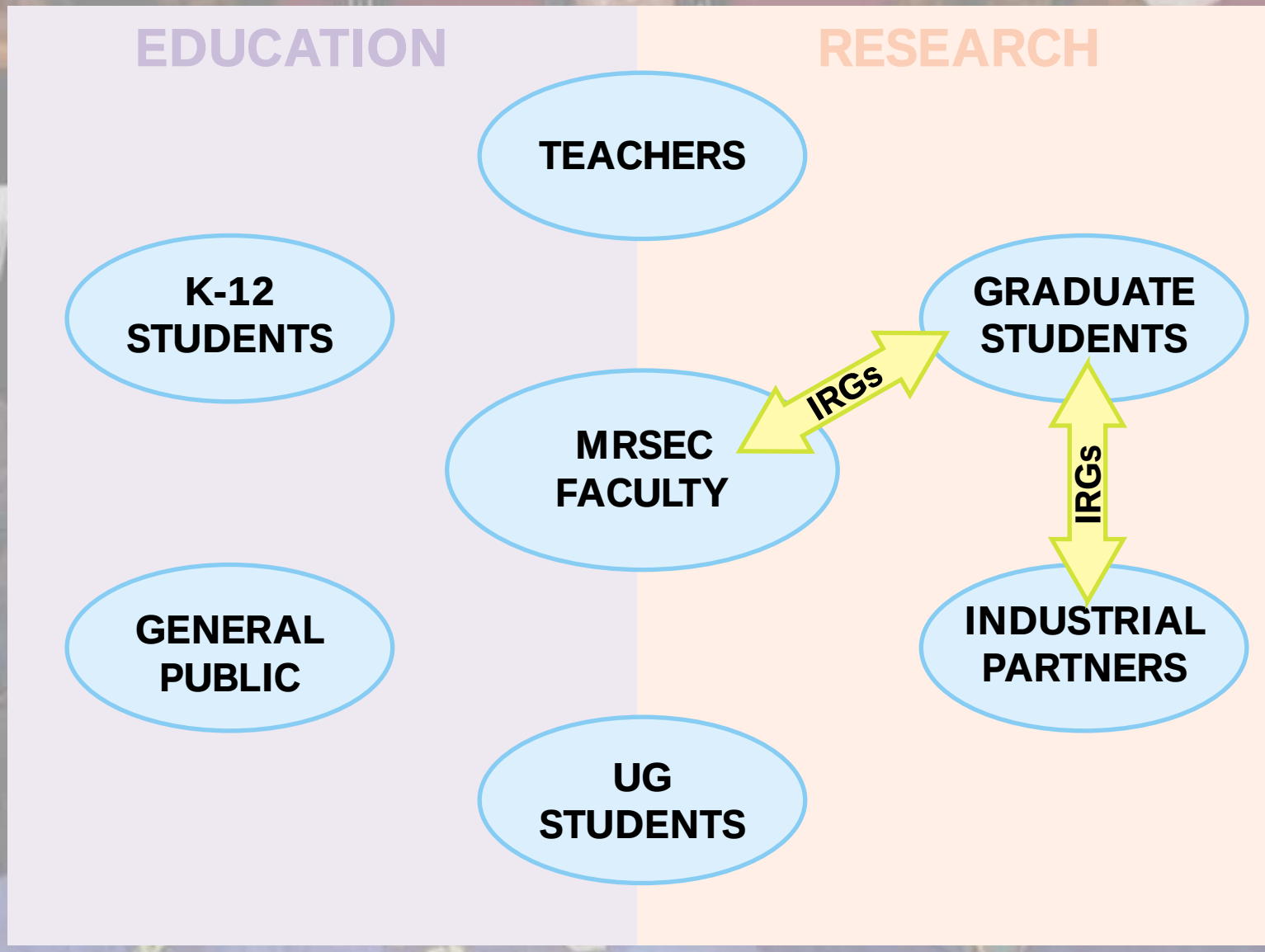
- **K-12 students**
- **general public/museums**
- **undergraduate students**
- **K-12 teachers**
- **women and minorities**
- **graduate students**

Materials Courses	**Kaxiras**	**45 students**
Facilities Courses	**MoberlyChan**	**65 students**

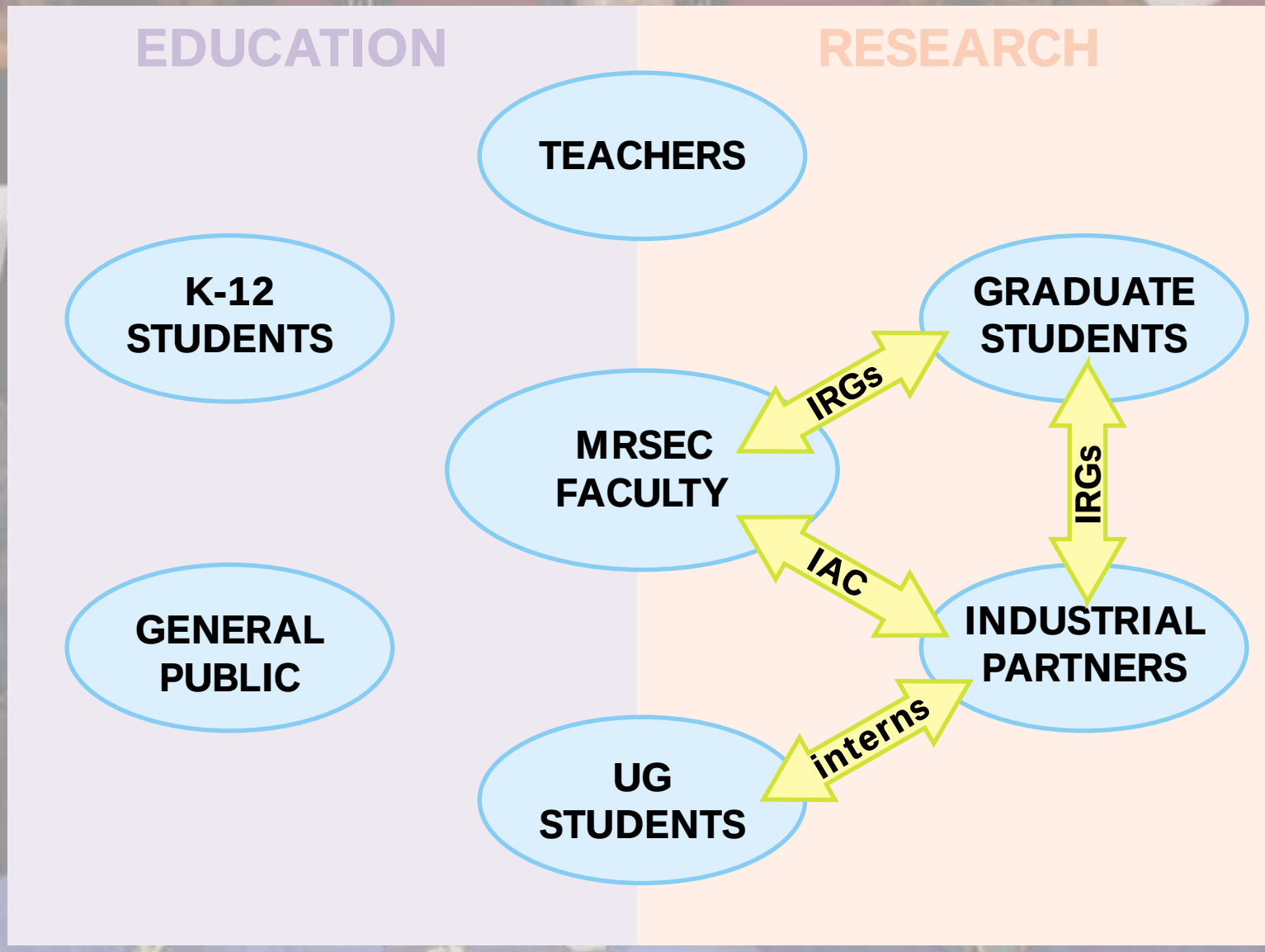
Making connections



Making connections



Making connections



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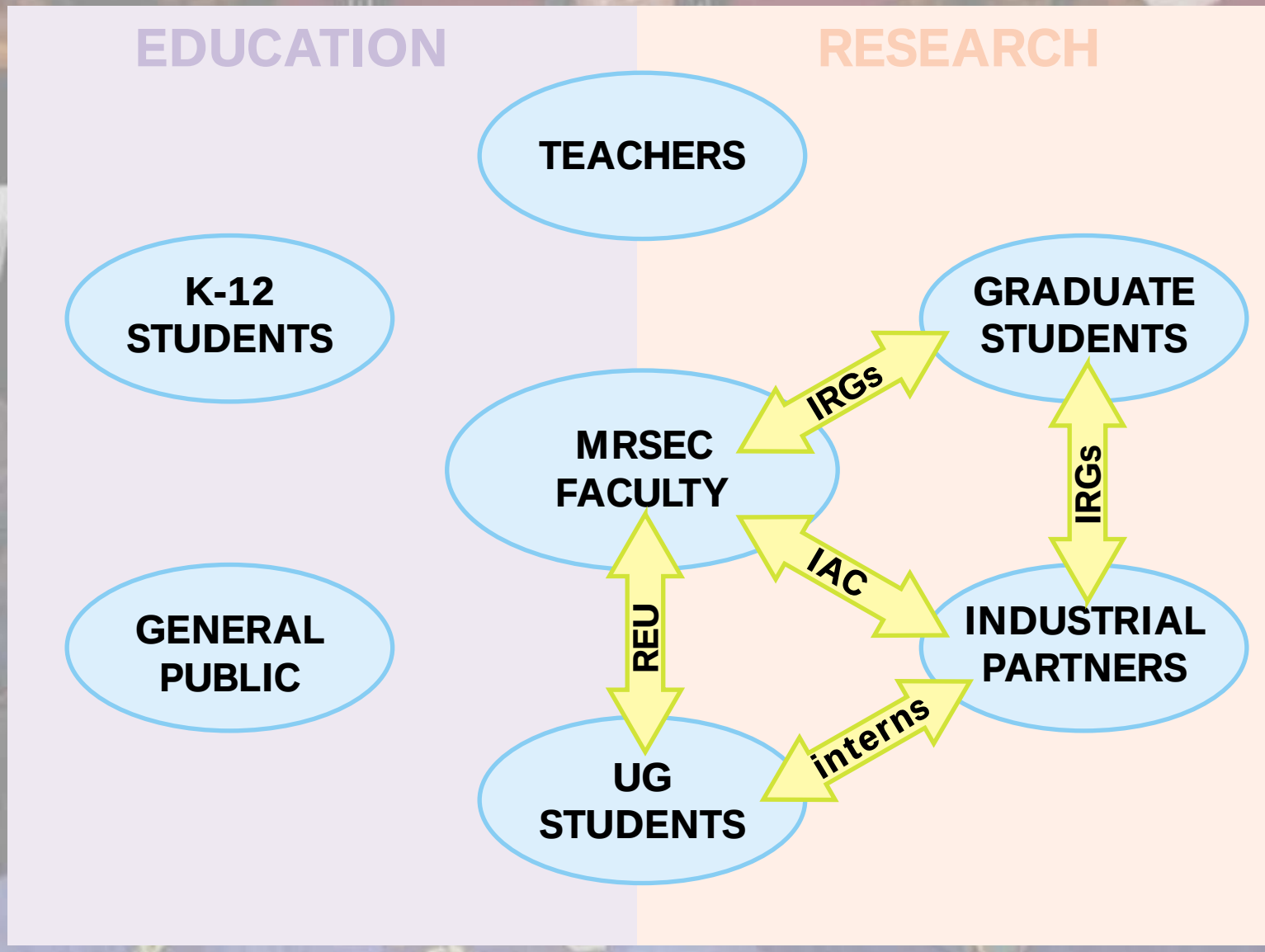

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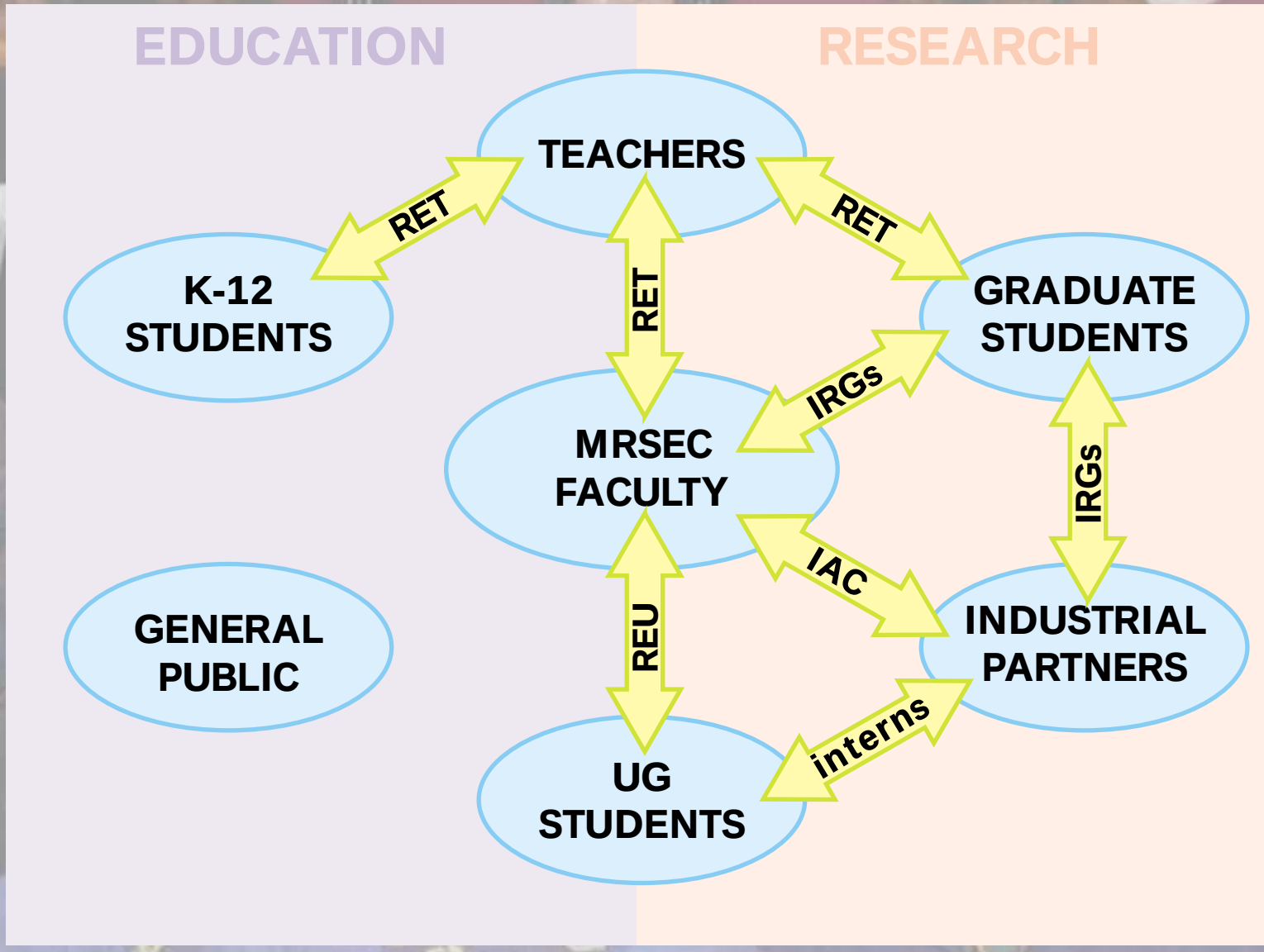

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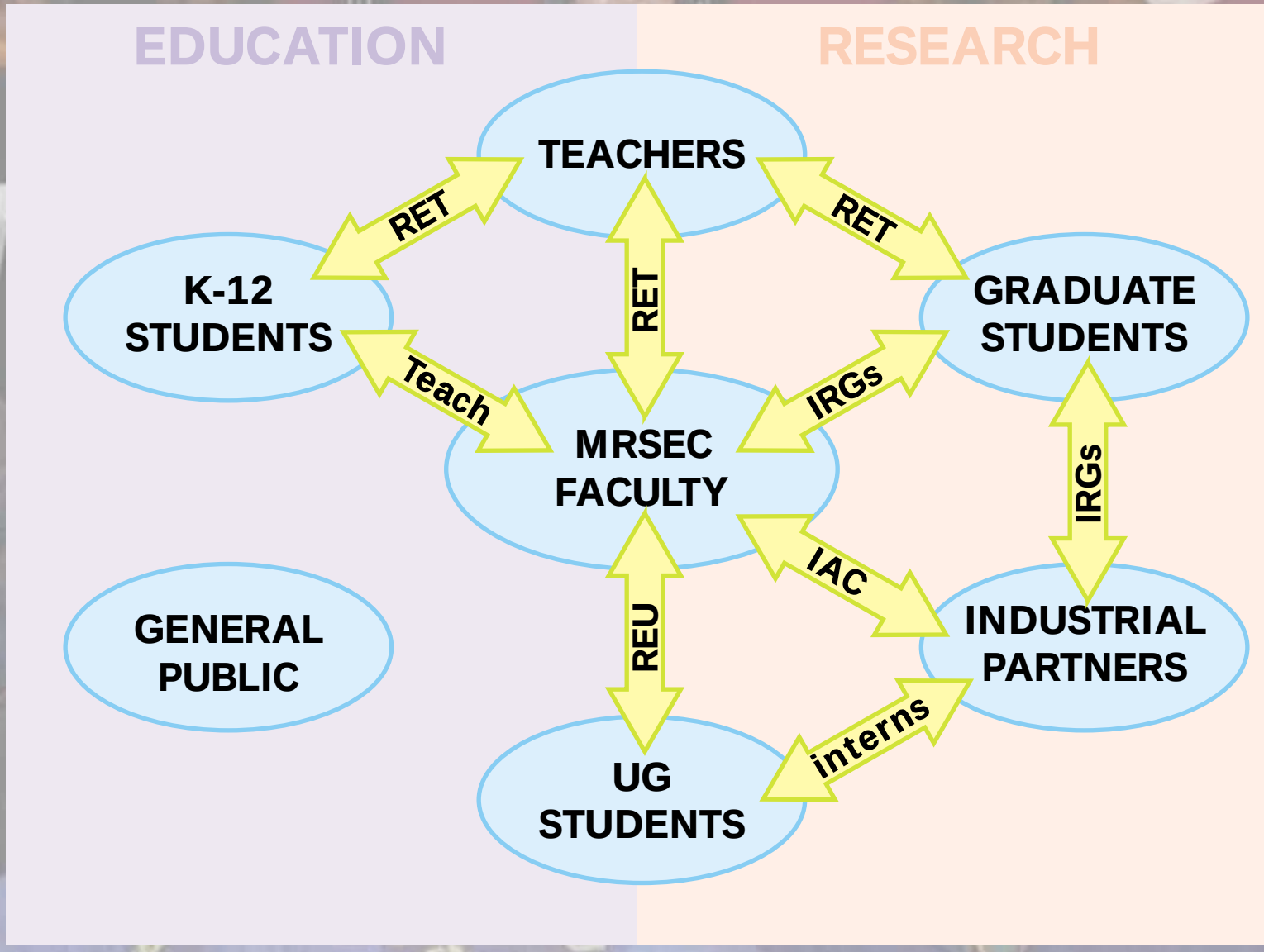

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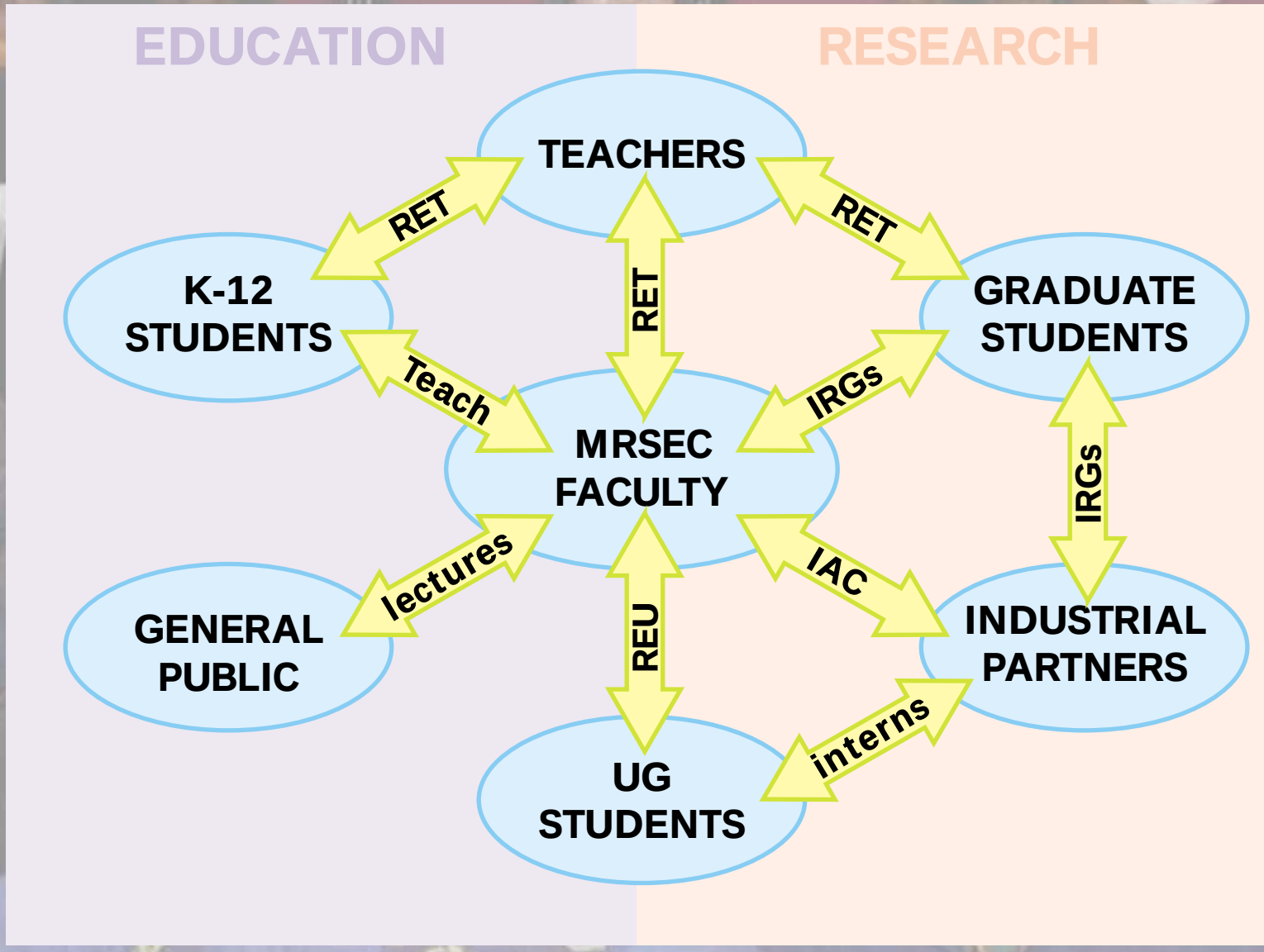

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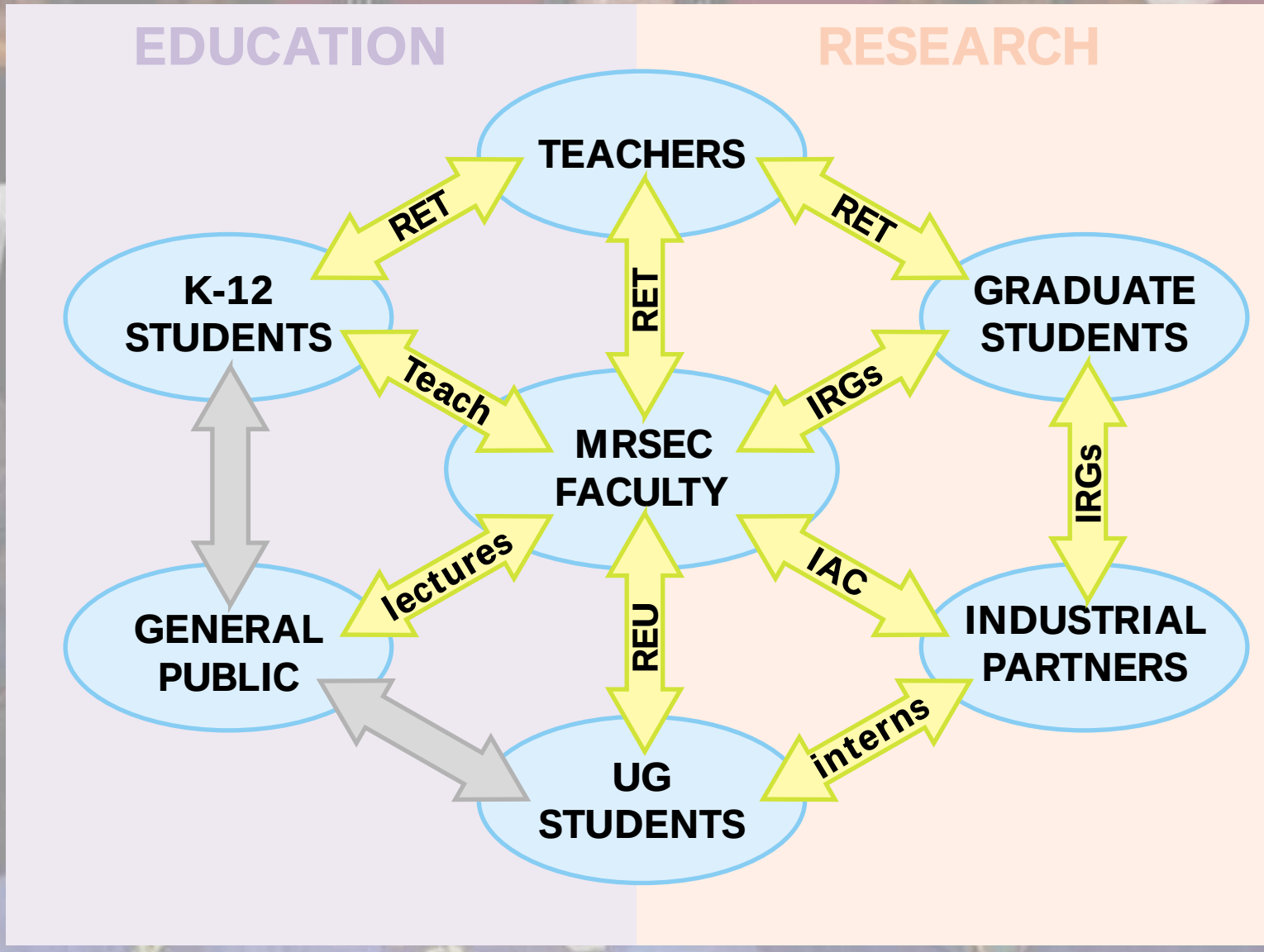


Broad Faculty Involvement

Project TEACH

The Educational Activities for Cambridge-Harvard

Project TEACH

Fall 2000 Semester

Oct. 20	Kennedy School I	Stone
Oct. 27	Kennedy School II	Golovchenko
Nov. 3	Agassiz School	Westervelt
Nov. 17	Fitzgerald School	Aziz
Dec. 1	Harrington School I	Vlassak
Dec. 8	Harrington School II	Spaepen
Dec. 15	Peabody School	Mazur

Project TEACH

Spring 2001 Semester

Feb. 2	**Haggerty School**	**Kaxiras**
Feb. 9	**King & King Open**	**Heller**
Feb. 16	**Make Up**	
Mar. 2	**Longfellow School I**	**Graham**
Mar. 9	**Longfellow School II**	**Prentiss**
Mar. 16	**Cambridgeport & Morse**	**Hau**
Mar. 23	**Tobin School I**	**Park**
Apr. 6	**Tobin School II**	**Weitz**
Apr. 27	**Fletcher & Maynard**	**MoberlyChan**

Project TEACH program

Science presentation

Project TEACH program

School group image

Project TEACH program

College admission and financial aid presentation

Project TEACH program

Campus tour and lunch with undergraduates

Project TEACH demographics

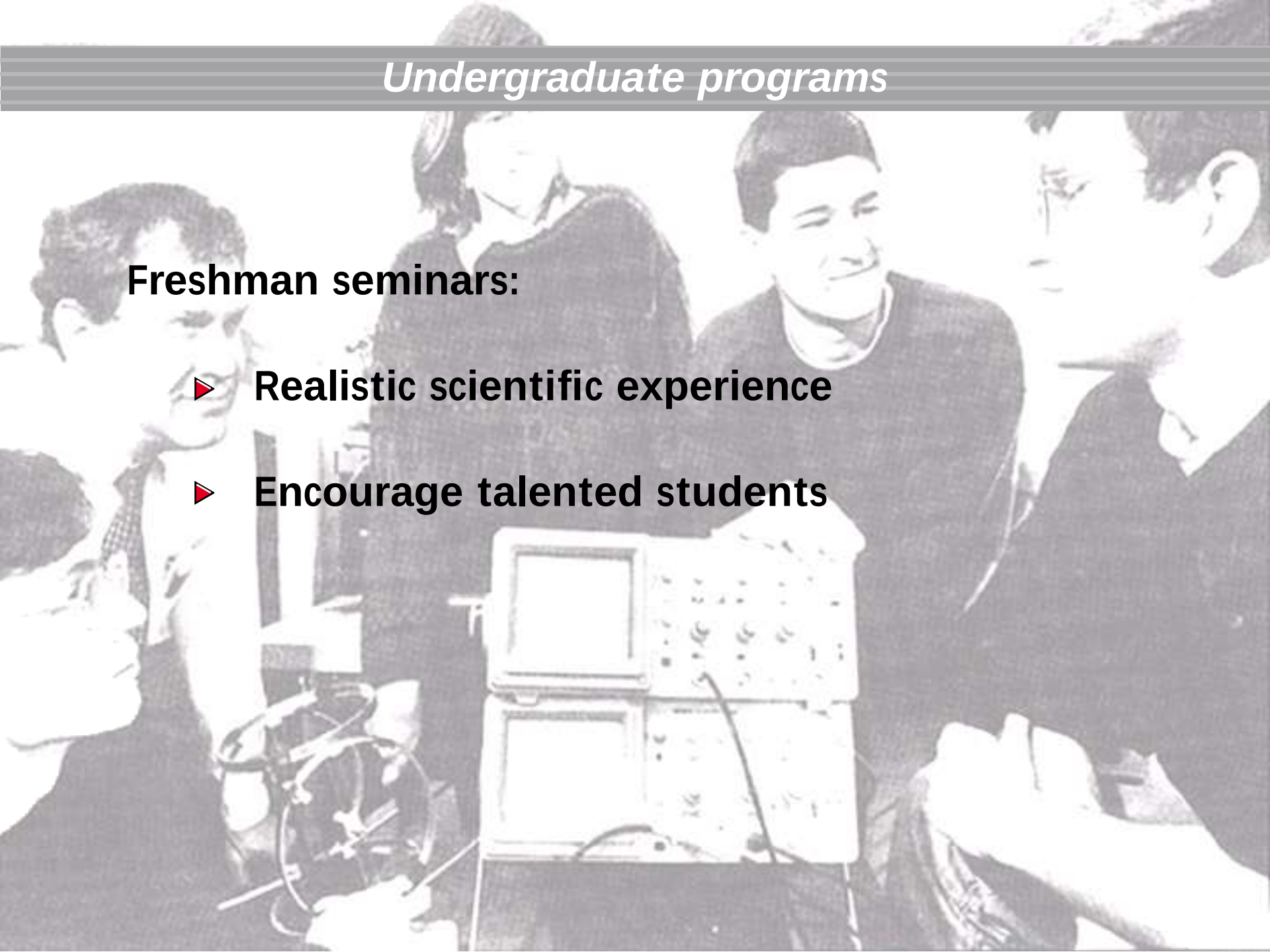
2001 Cambrigde Public School 7th graders

Female	49.5%
Male	50.5%
Black	35.3%
Hispanic	13.8%
Asian	7.7%
Native American	0.2%
White	43.0%

Project TEACH follow-up activities

- **Newsletter questionnaire**
- **Homework hotline**
- **Make it happen!**
- **Career days**
- **Parent-teacher nights**
- **End-of-year assessment**

Undergraduate programs



Freshman seminars:

- **Realistic scientific experience**
- **Encourage talented students**

Undergraduate programs

Research Experience for Undergraduates:

- **Summer research projects for undergraduates**
- **Matching funds provided DEAS and College**
- **Interdisciplinary research environment**
- **Use of shared experimental facilities**

REU Participants

Summer 2000

REU Participant	*Institution*	*Project Title*
Michelle Burgos	U. Puerto Rico	Synthesis of Mixed Self-Assembled Monolayers and Controlling Protein Absorption
Kyle Clark	Harvard	Development of an Apparatus to Measure Mechanical Properties of Thin Films
Debajyoti Datta	Harvard	Sub-cellular Micromachining
Nathan Ferris	U. Calif. Berkeley	Fabrication and Testing of Components for Microfluidic Analysis Systems
Nicholas Guydosch	Harvard	Studies of Single Molecule Enzymatic Kinetics
Michael Hermele	Harvard	Quasiparticle Excitations in a Regular Array of Vortices in a d-wave Superconductor
Alan Jamison	Harvard	Studies of Femtosecond Laser-damaged Glass
James Krocak	U. Minnesota	Studies of the Microscopic Flow Characteristics of Foams
Andrea Kurtz	Harvard	Synthesis of Aluminum Nanocrystals
Roberto Martinez	Christian Brothers	Electrical Transport in Quantum Dots and Superlattices
Alexander Mastroianni	Harvard	Controlled Patterning of Nanotube Catalysts
Anthony Mroczkowski	Cooper Union	Hydrogen Adsorption and Storage in Nanotubes
Omoregie Osahan	Harvard	Fabrication of 3-D Electronic Devices by Self-assembly
Marlyn Rivera	U. Puerto Rico	Inverse Opaline Ceramics from Single-source Ceramics
Anat Samoilov	Technion	Growth and Characterization of ZnO Films
Adam Shepard	Bates	Fabrication of Quantum Dots
Aaron Snead	Harvard	Self-assembly of Mesoscale Size Hexagonal Plates
Matthew Thrasher	Harvard	Construction of a Beamline to Study Quantum Tunneling in Nanostructures
Luis Valentin	U. Puerto Rico	Damage and Transition Thresholds in Semiconductors
Dorothy Wang	U. Pennsylvania	Effects of the Directional Drying of Mud

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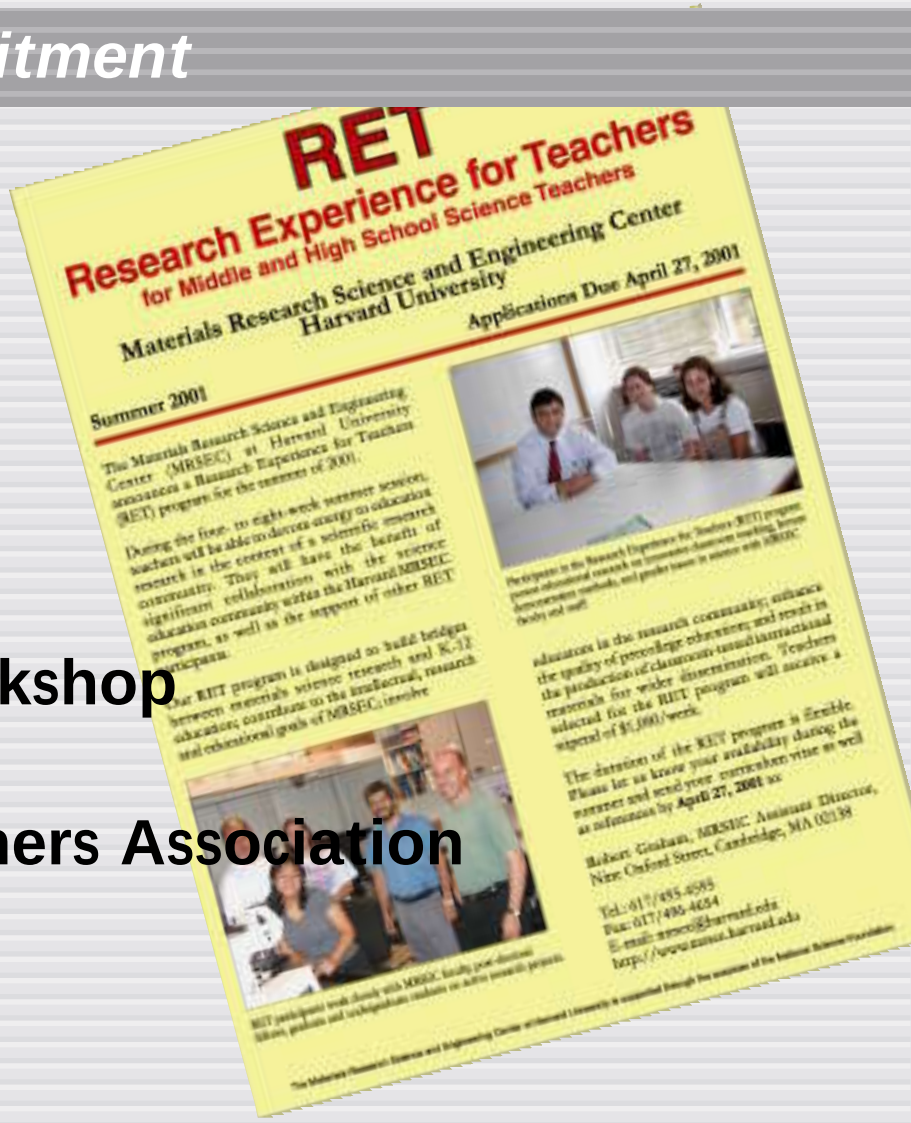
RET recruitment

- RET flyer
- MASS newsletter
- Peer Instruction Workshop
- Boston Science Teachers Association



RET

Research Experience for Teachers

for Middle and High School Science Teachers

Materials Research Science and Engineering Center

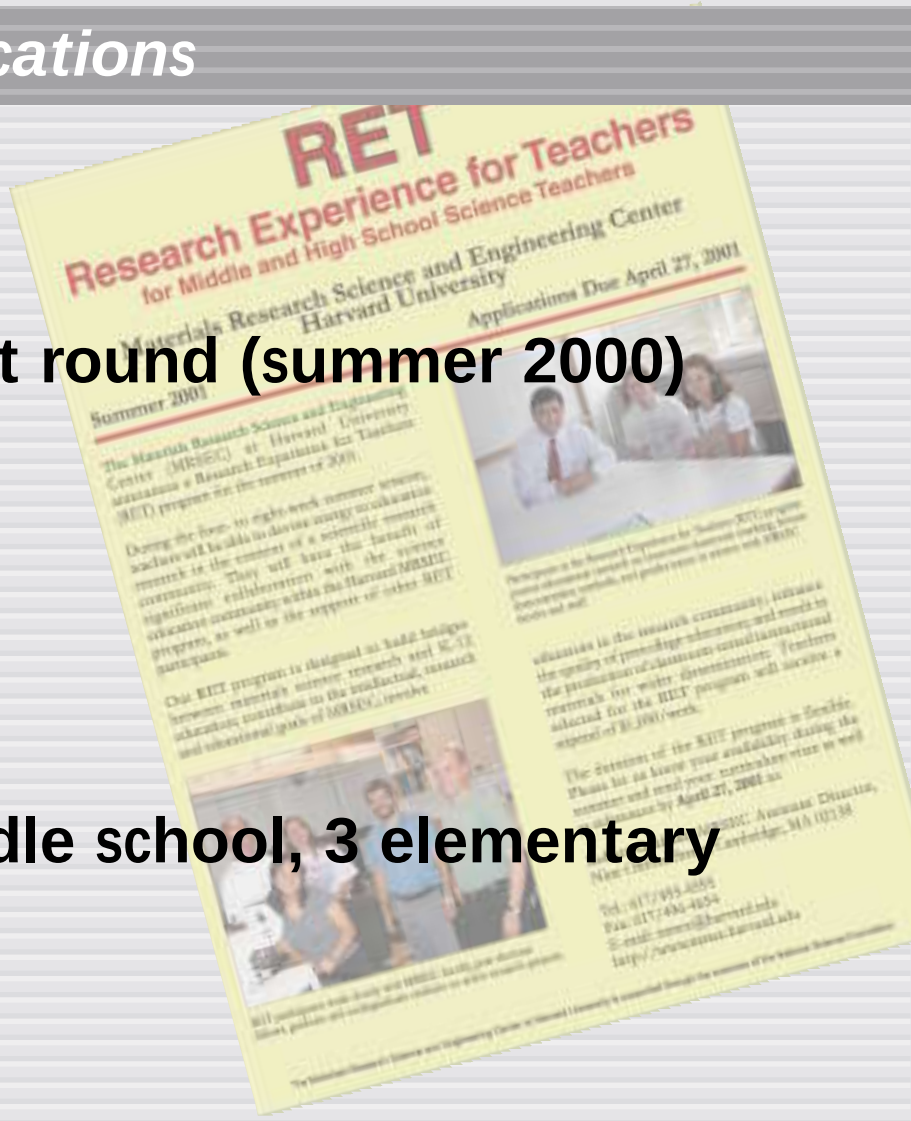
Harvard University

Applications Due April 27, 2001

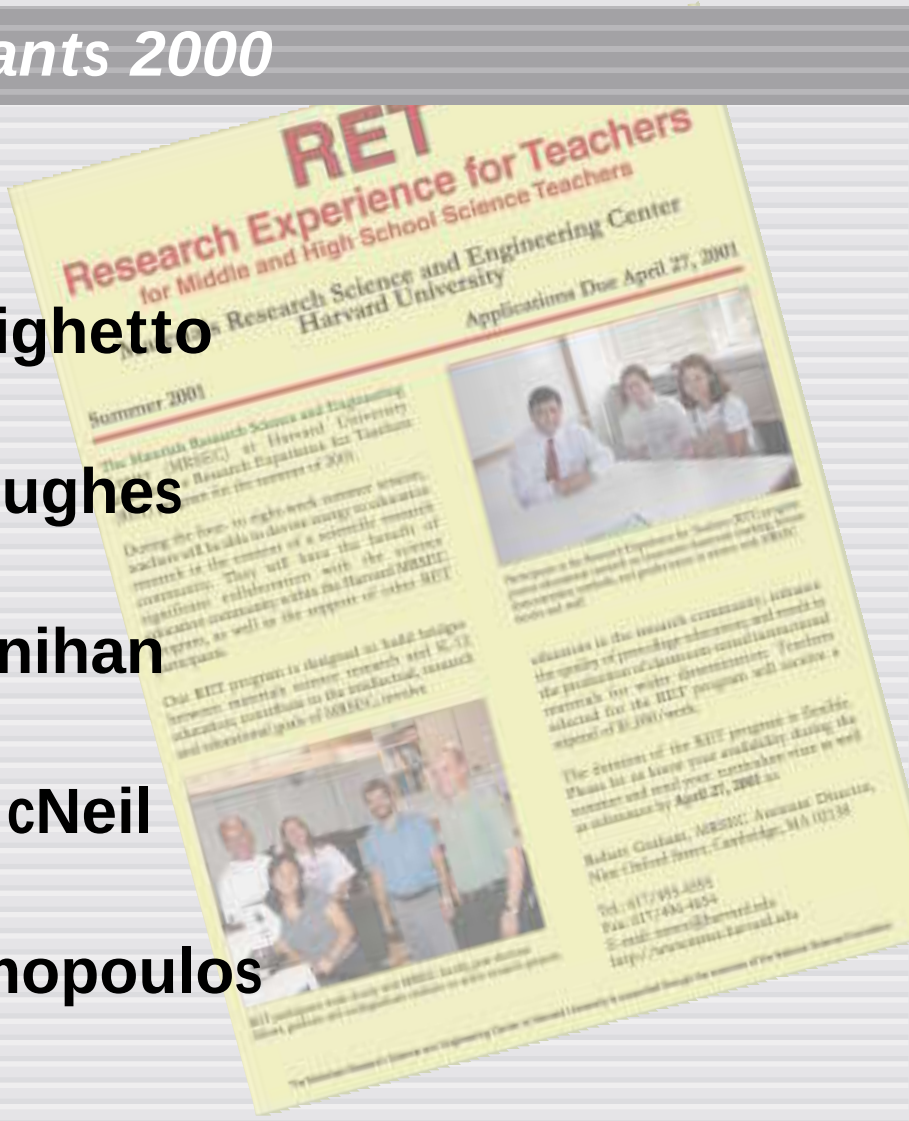
Summer 2001

RET applications

- **13 applicants for first round (summer 2000)**
- **10 women, 3 men**
- **13 public school**
- **7 high school, 3 middle school, 3 elementary**



RET participants 2000



Gina Andrighetto

Charles Hughes

Kristy Lenihan

James McNeil

Ceanne Tzimopoulos

Adam Fagen, RET coordinator

RET participants 2000

Gina Andrighetto

High School, Chemistry

Project (Mazur Group):

Research: laser-etching of silicon

Education: effectiveness of student-centered classroom

RET participants 2000

Charles Hughes

Elementary School, Science

Boston Public School coordinator

Project (Weitz Group):

Multiparticle tracking in cells

RET participants 2000

Kristy Lenihan

High School, Physics

Project (Mazur Group):

Research: Micromachining of transparent materials

Education: Development of optics curriculum

RET participants 2000

Kristy Lenihan

High School, Physics

Project (Mazur Group):

Research: Micromachining of transparent materials

Education: Development of optics curriculum

will present at MRS meeting in San Francisco!

RET participants 2000

James McNeil

Middle School, Geology

Project (Stone Group):

Effect of bubble size on foam drainage

RET participants 2000

Ceanne Tzimopoulos

High School, Biology

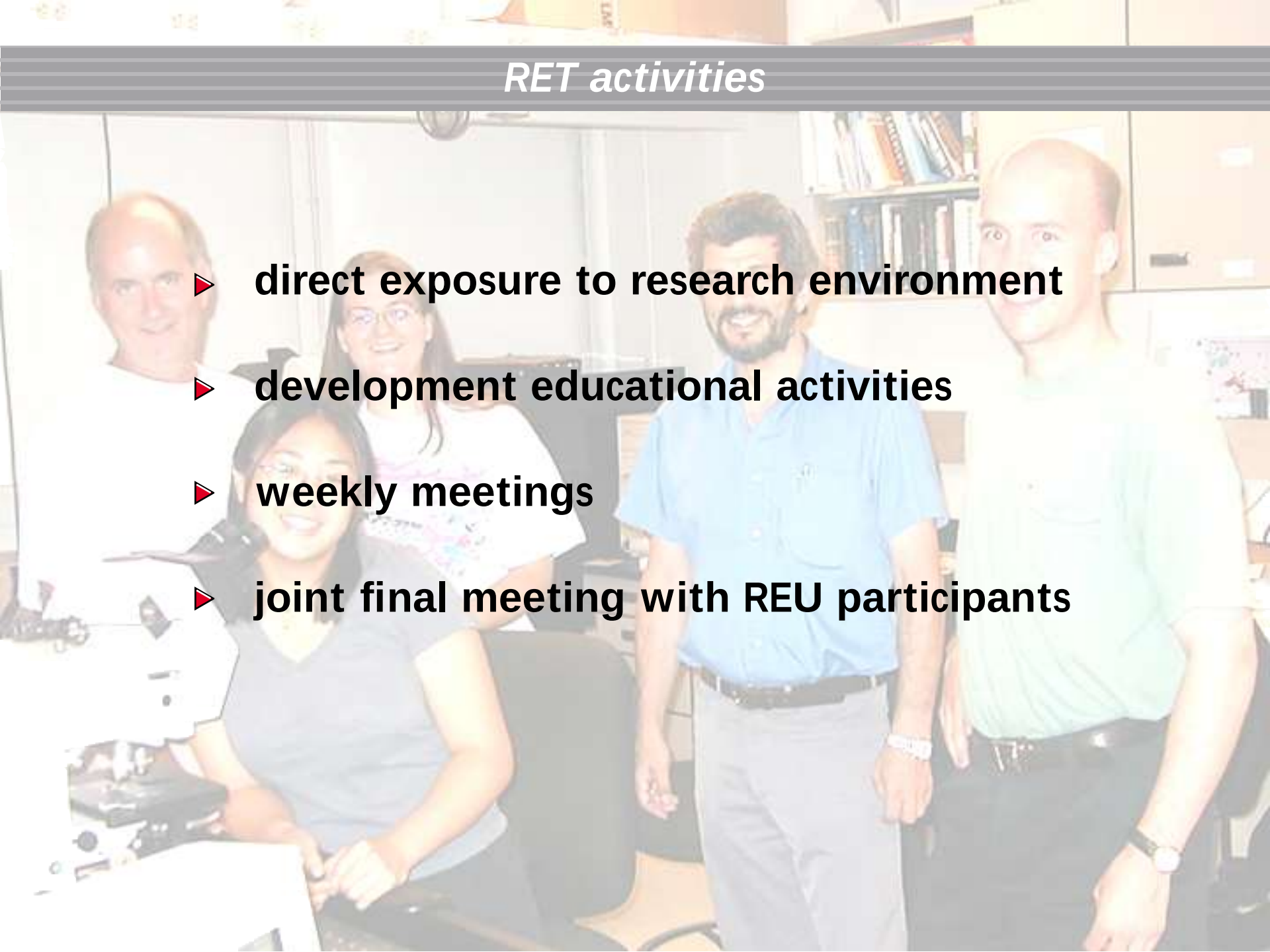
Project (Mazur Group):

Research: photodisruption of biological tissue

Education: development of Biology ConcepTests

RET activities

RET activities



- **direct exposure to research environment**
- **development educational activities**
- **weekly meetings**
- **joint final meeting with REU participants**

RET activities

Follow up

- **evaluation**
- **ongoing curriculum development**
- **school visits**
- **2nd year**

RET program

- **great success!**
- **satisfied teachers**
- **broad MRSEC personnel involvement**
- **expanded program this year**

Teacher Workshops

Teacher Workshops

- on average 1/year
- attended by ~50 teachers/yr
- run by RET teachers in future?

Teacher Workshops

Typical program:

7:00 Welcome by Dean Narayanamurti

7:10 Presentation

8:10 Break

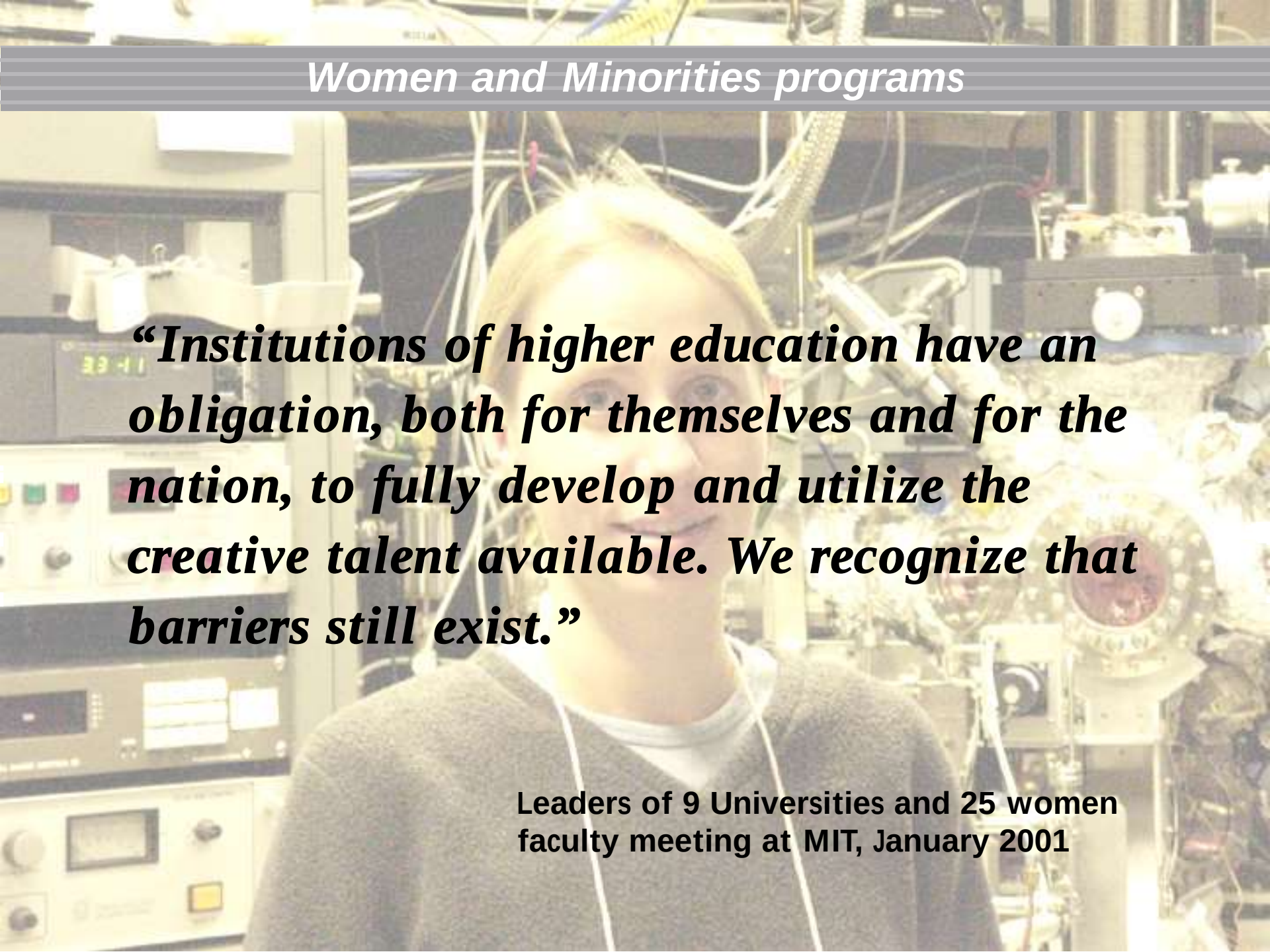
8:25 Demonstration and Discussion

9:00 Adjourn

Teacher Workshops

- **high impact (100 teachers x 60 students/year)**
- **very positive feedback**
- **good attendance**
- **high involvement**
- **excellent RET recruiting opportunity**

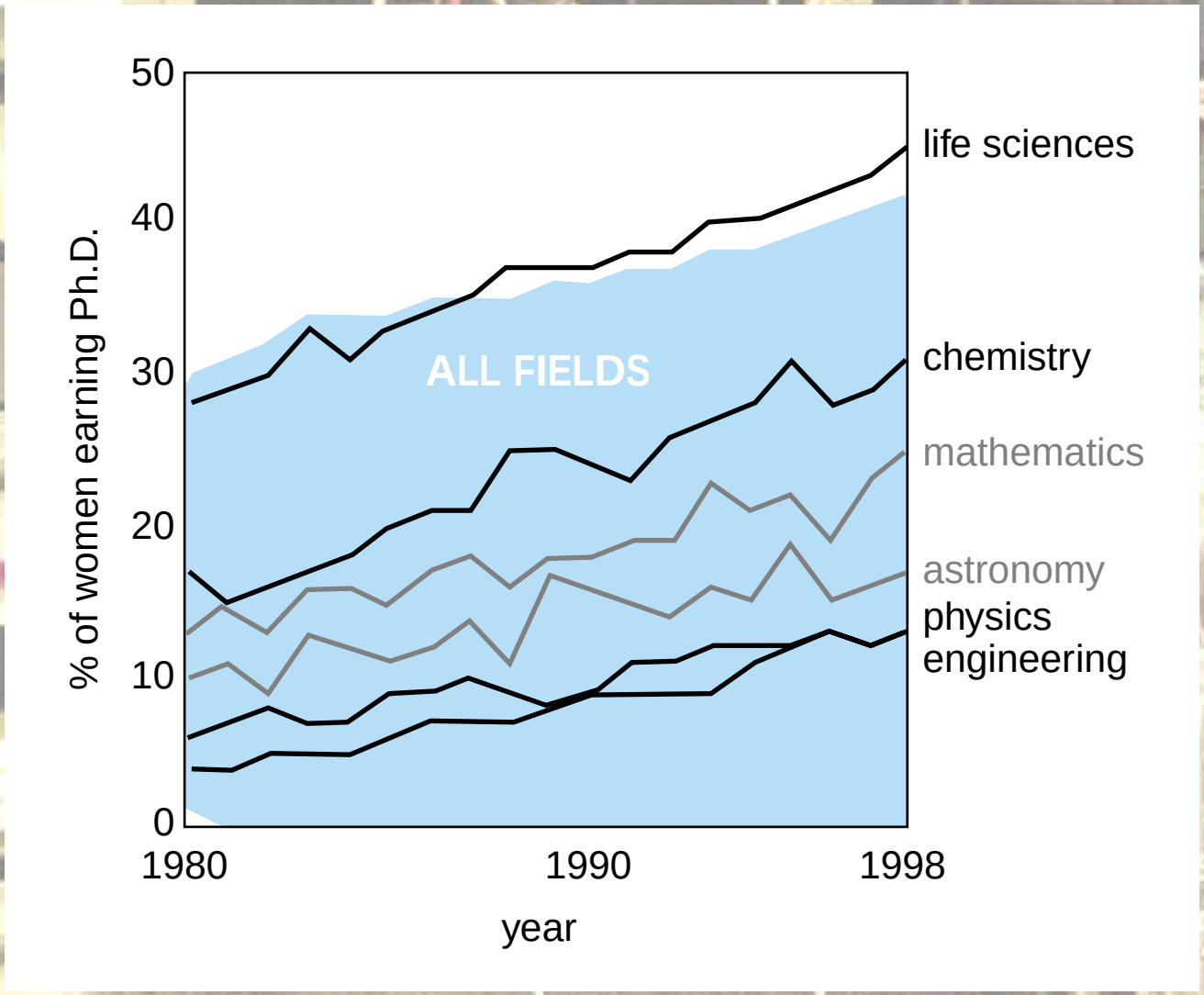
Women and Minorities programs



"Institutions of higher education have an obligation, both for themselves and for the nation, to fully develop and utilize the creative talent available. We recognize that barriers still exist."

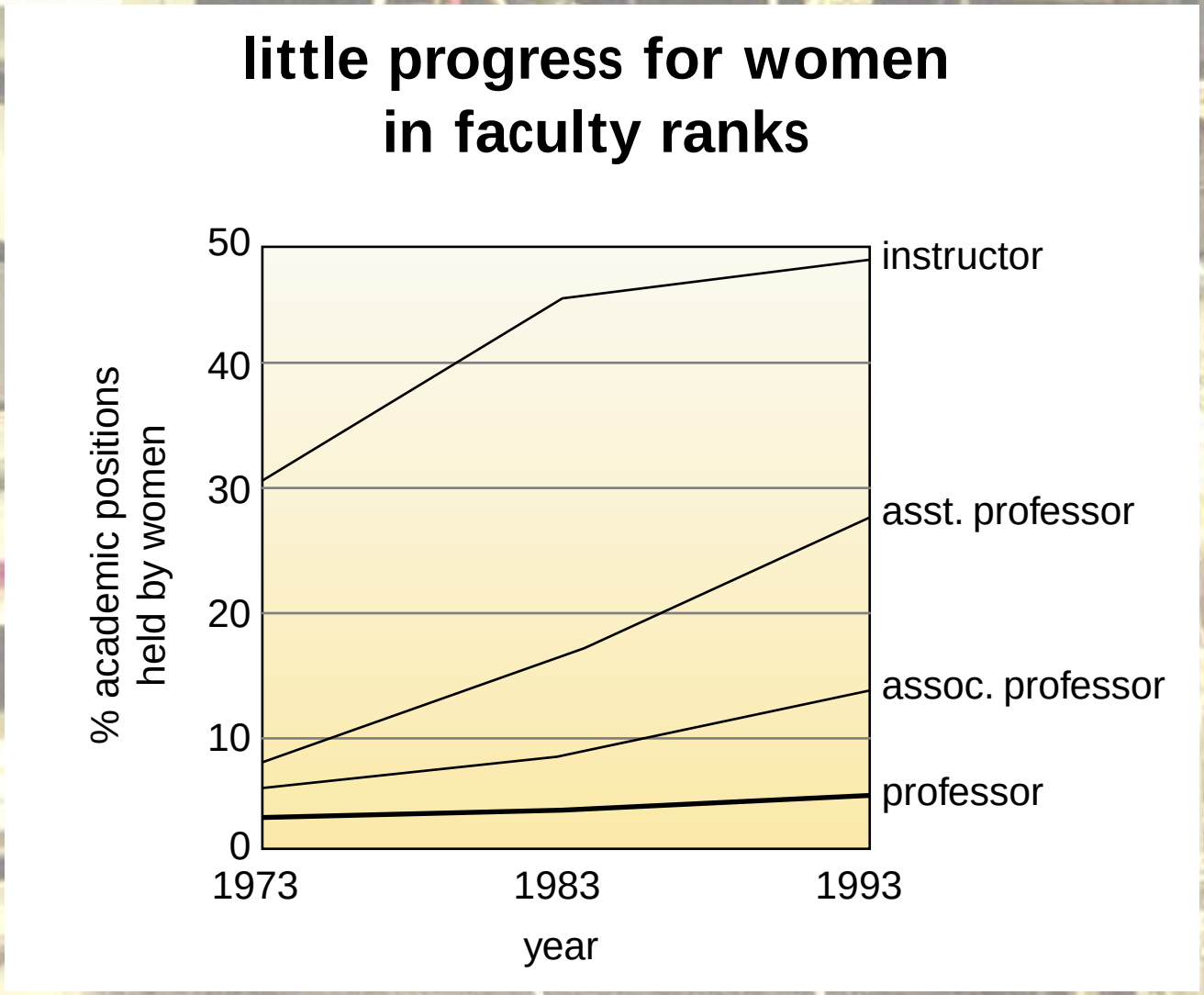
Leaders of 9 Universities and 25 women faculty meeting at MIT, January 2001

Women and Minorities programs



APS News, The Back Page, January 2000

Women and Minorities programs



Madeleine Jacobs, ACS address; *Journal Chem. Educ.* 73, 139 (1996)

NSF ADVANCE Program

Goal: Increase participation of women

in academic science and engineering

Harvard MRSEC Women & Minorities program

Postdoctoral Research Fellowship for Women and Minorities in Materials Science:

- **MRSEC faculty propose candidates to Executive Committee**
- **partnership with Radcliffe institute**
- **connections with minority faculty and researchers throughout University**

Harvard MRSEC Women & Minorities program

Goals of Research Fellowship:

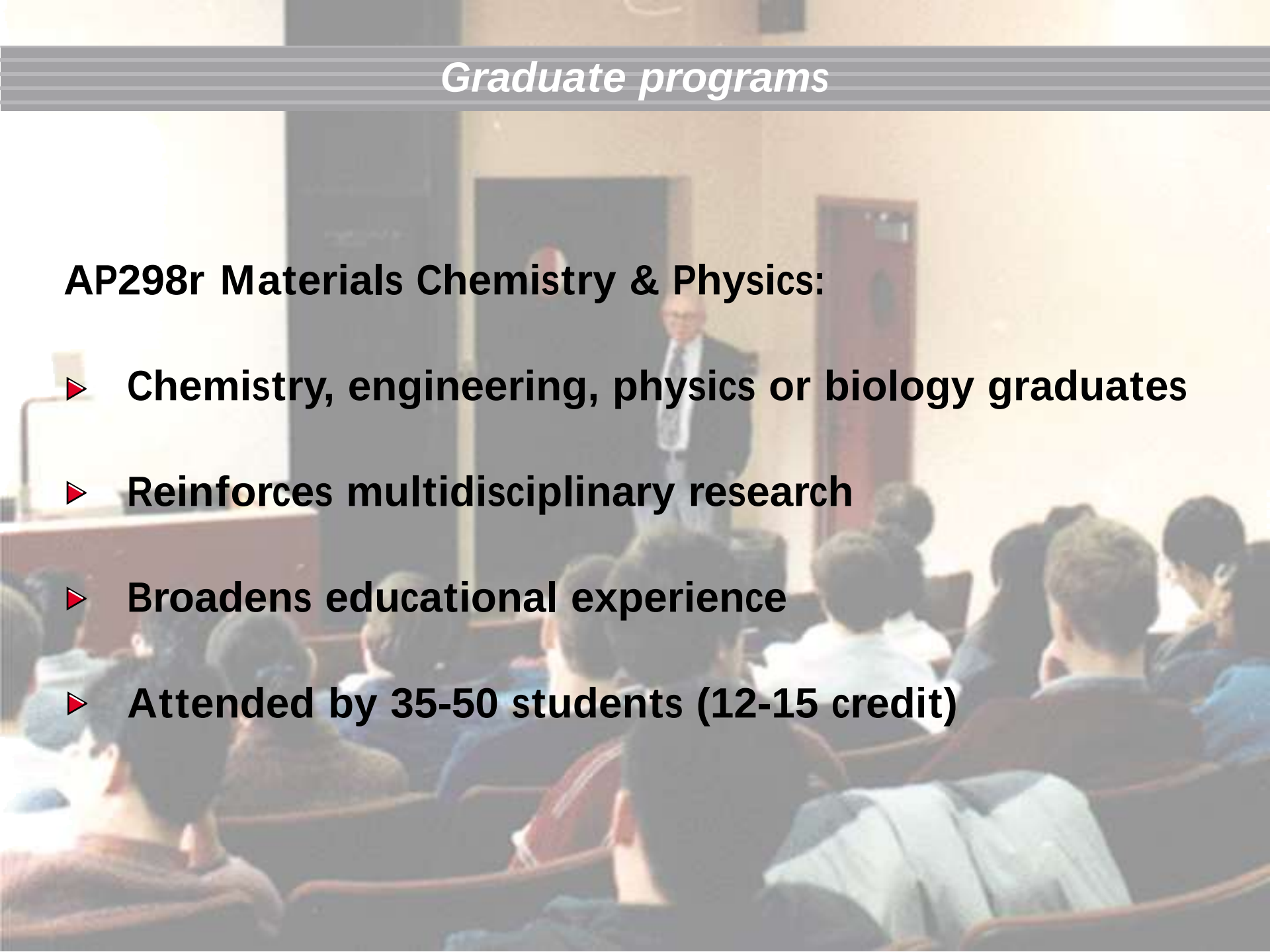
- **promote career development via access to cutting-edge research facilities and a strong intellectual environment**
- **provide strong pool of potential faculty candidates for universities and scientific community at large**

Graduate programs

Academic courses using shared facilities

- **Advanced laboratory in Applied Physics**
- **Experimental Physical Chemistry**

Graduate programs



AP298r Materials Chemistry & Physics:

- **Chemistry, engineering, physics or biology graduates**
- **Reinforces multidisciplinary research**
- **Broadens educational experience**
- **Attended by 35-50 students (12-15 credit)**

AP298r: Materials Chemistry & Physics

Applied Physics 298r. Materials Chemistry and Physics: Seminar
Catalog Number: 7500

Efthimios Kaxiras, Michael J. Aziz, Frans A. Spaepen, and Howard A. Stone
Half course (spring term). Hours to be arranged.

Each year materials-related topics are chosen from the following: Optical and Electronic Properties; Mechanical Properties; Surfaces and Interfaces; Nanoscale Phenomena; Organic Materials; Synthesis and Fabrication; Characterization Techniques; Solid State Devices and Structural Applications. Each chosen topic is discussed in about five didactic lectures. A paper and oral presentation on two of the principal topics under discussion will be assigned.

Note: Expected to be given in 2001–02. Taught by faculty from Chemistry, Physics, and the Division of Engineering and Applied Sciences who are associated with Harvard's Materials Research Science and Engineering Laboratory. Suitable for graduate students with undergraduate concentrations in chemistry, engineering, or physics having present or potential research interests in this field.

AP298r: Materials Chemistry & Physics

I. Soft Condensed Matter (D. Weitz)

1. Introduction to Soft Condensed Matter and Elasticity	Weitz/Hutchinson
2. Liquid Crystals, Fluid Surfaces, Surfactant Monolayers	Pershan
3. Fluids, Complex Fluids and Polymers	Stone
4. Self Assembly of Surfactants in 3D; Self Assembled Monolayers	Whitesides
5. Colloids — Structure and Rheology	Weitz
6. Micro-Electro-Mechanical Systems	Brockett

II. Micromechanical Systems (M. Aziz)

7. Phenomenology of Materials	Hutchinson
8. Dislocations	Spaepen
9. Introduction to Crack Mechanics	Rice
10. Dynamic Fracture, Friction and Faulting	Rice
11. Mechanics of thin films	Vlassak

III. Biological Systems (H. Stone)

12. Structure and Information Flow in Living Systems	Lue
13. Genomics	Shalon
14. The Motile Behavior of Bacteria	Berg
15. Electronic DNA sequencing	Branton
16. Membranes and Biophysics	Nelson
17. The Mechanics of Cell Regulation	Ingber
18. Protein Folding and Structure Prediction Problem	Shakhnovich

IV. Nanostructures (E. Kaxiras)

19. Nanophysics	Halperin
20. Small Electronics and Quantum Chaos	Marcus
21. Semiconductor Nanostructures	Westervelt
22. Near-Field Optical Microscopy	Xie
23. Ballistic Transport in Semiconductor Nanostructures	Narayanamurti
24. Formation and Stability of Nanoscale Features	Aziz

AP298r: Materials Chemistry & Physics

Spring 2000 Paper Topics

Name	*Paper*	*Reader*
Nick Choly	MEMS Issues: The LIGA Process and Micro-Scaling	Brockett
Jay Ewing	Liquid Crystal Based Transmissive Displays	Pershan
Christopher Gabel	Self-Assembly of Simple Systems on the Meso and Micro Scales and its Relevance to Self-Assembly in Biology	Whitesides
Lauren Hough	Elastic Modulus of a Fractal Colloidal Gel	Weitz
Pallop Karnchanaphaurach	Two Dimensional Phase Transitions in Colloidal Suspensions: The Development and the Current Status	Weitz
Kyoung-has Kim	Microfabrication Using Organic Self-Assembled Monolayer	Whitesides
Andrew Kowalevicz	Laser-Assisted Microfabrication: Techniques and Applications	Kaxiras
John Krug	The Effects of Sodium Chloride Concentration on the Aggregation of Colloidal Gold	Weitz
Wenjie Liang	Colloids and Colloidal Crystals	Weitz
Jessamine Ng	Liquid Crystals	Pershan
Jennifer Phend	Surfactant Self-Assembly and Biomimetic Structures	Whitesides
Daniel Wolfe	Colloidal Particles and their Uses as Biological Probes	Weitz
Wei Yi	A Brief Introduction of Colloids and Colloidal Assembles	Weitz

AP298r: Materials Chemistry & Physics

Spring 2000 Oral Presentations

TUESDAY, MAY 23

Daniel Wolfe 1:00–1:35 pm
Developments in the Fabrication and Application of Photonic Materials

John Krug 1:35–2:10 pm
Surface Enhanced Raman Scattering and its Potential Applications in Biochemistry

Lauren Hough 2:10–2:45 pm
Mechanical Forces on Cells and How they Affect Gene Expression

Jennifer Phend 2:45–3:20 pm
Proteomics

Jay Ewing 3:30–4:05 pm
DNA Sequencing Using Micropores

Chris Gabel 4:05–4:40 pm
A Physical Investigation of DNA Transport Through a Nanopore

Pallop Karnchanaphanurach 4:40–5:15 pm
Fluorescence Depolarization of Tryptophan Residues in Lysozyme: A Molecular Dynamics Simulation Approach

WEDNESDAY, MAY 24

Andrew Kowalevicz 1:00–1:35 pm
Optical Coherence Tomography

Jessamine Ng 1:35–2:10 pm
Nanofabrication and Cells

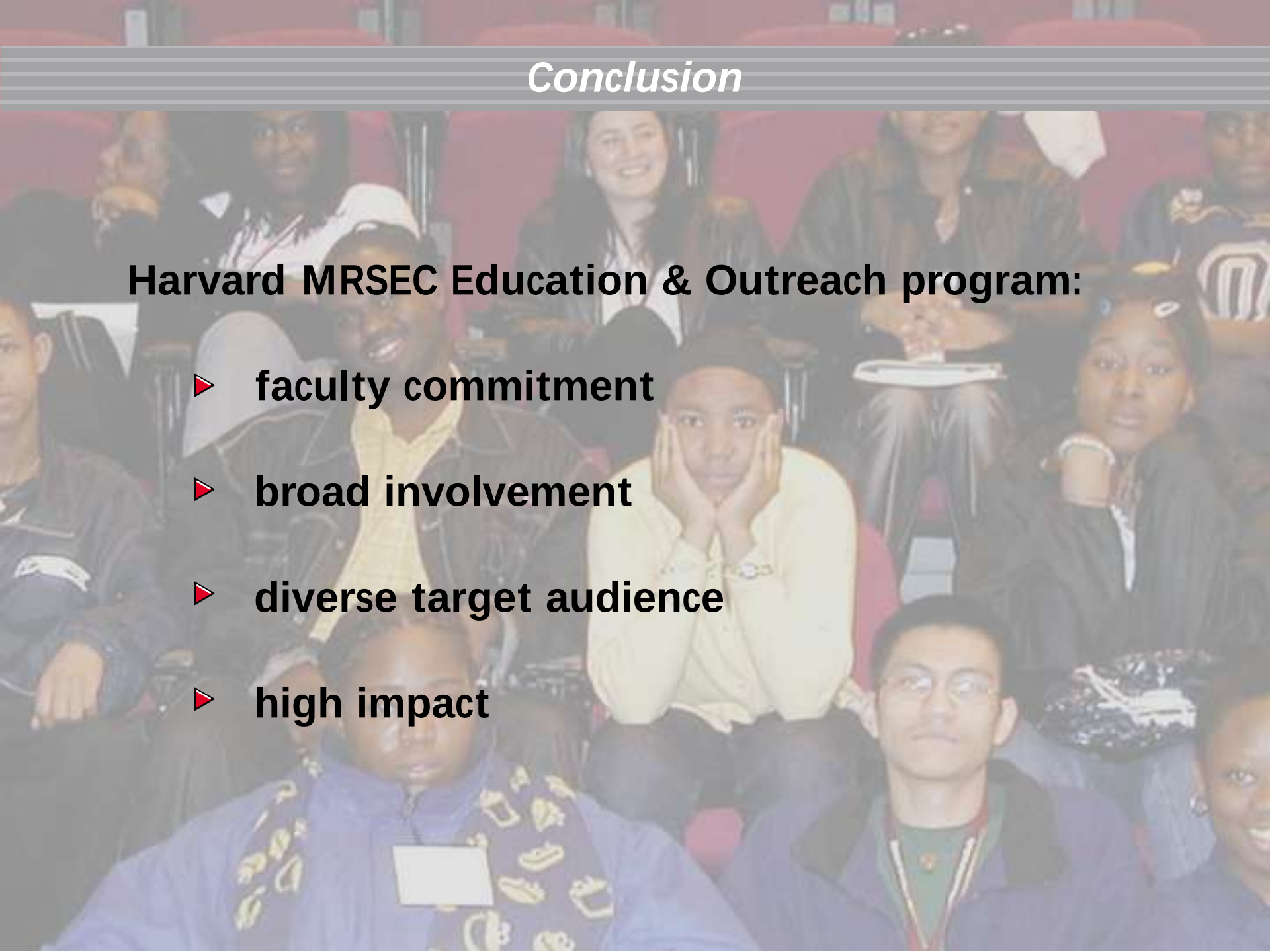
Kevin Kim 2:10–2:45 pm
Coherent Spin Transport in Semiconductor Structures: a Step Toward Magnetoelectronics

Nick Choly 3:00–3:35 pm
The Landauer Theory of Transport Applied to Conduction in Nano-Wires

Wenjie Liang 3:35–4:10 pm
Electron Transport Through Quantum Dot

Wei Yi 4:10–4:45 pm
Electron Transport in Quantum Dot

Conclusion



Harvard MRSEC Education & Outreach program:

- **faculty commitment**
- **broad involvement**
- **diverse target audience**
- **high impact**