Project-Based Learning

Designing Powerful Learning Experiences

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MS4SSA

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Most Important College Learning Outcomes, According to US Employers

1. Ability to communicate orally
2. Ability to work effectively with others
3. Ability to communicate in writing
4. Ethical judgment and decision-making
5. Critical thinking and analytical reasoning
6. Ability to apply knowledge and skills to real-world settings

91% of employers agree that these abilities are more important than the student's major area of study to achieve success in their careers

Source: Hart Research Associates, 2015

Projects Ask Students to…

- Apply knowledge to address authentic problems
- Work productively with other people
- Learn about new topics independently
- Communicate effectively in written, oral, and visual forms
- Deliver meaningful results

"High Impact" Practices Shown to Improve Student Learning *(Kuh, AAC&U, et al.)*

- First-Year Seminars and Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing-Intensive Courses
- Collaborative Assignments and Projects
- Undergraduate Research
- Diversity/Global Learning
- Service Learning/Community-Based Learning
- Internships
- Capstone Courses and Projects

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Essential Elements of Project-Based Learning

Buck Institute of Education

- **Key Knowledge, Understanding, and Skills –** knowing what you want students to gain
- **Challenging Problem or Question** - at the appropriate level of challenge
- **Sustained Inquiry** - an extended process of asking questions, finding resources, and applying information
- **Authenticity** - real-world context, tasks and tools, quality standards, or impact

Essential Elements of Project-Based Learning

Buck Institute of Education

- **Student Voice & Choice** - students make decisions, including how they work and what they create
- **Reflection** - students reflect on learning, the effectiveness and quality of their work, and obstacles
- **Critique & Revision** - students receive and use feedback to improve their process and products
- **Public Product** - students make their project work public by explaining, displaying and/or presenting it beyond the classroom

Changing Faculty and Student Roles

- Faculty move away from
  - Dispensing information
  - Authority and expert

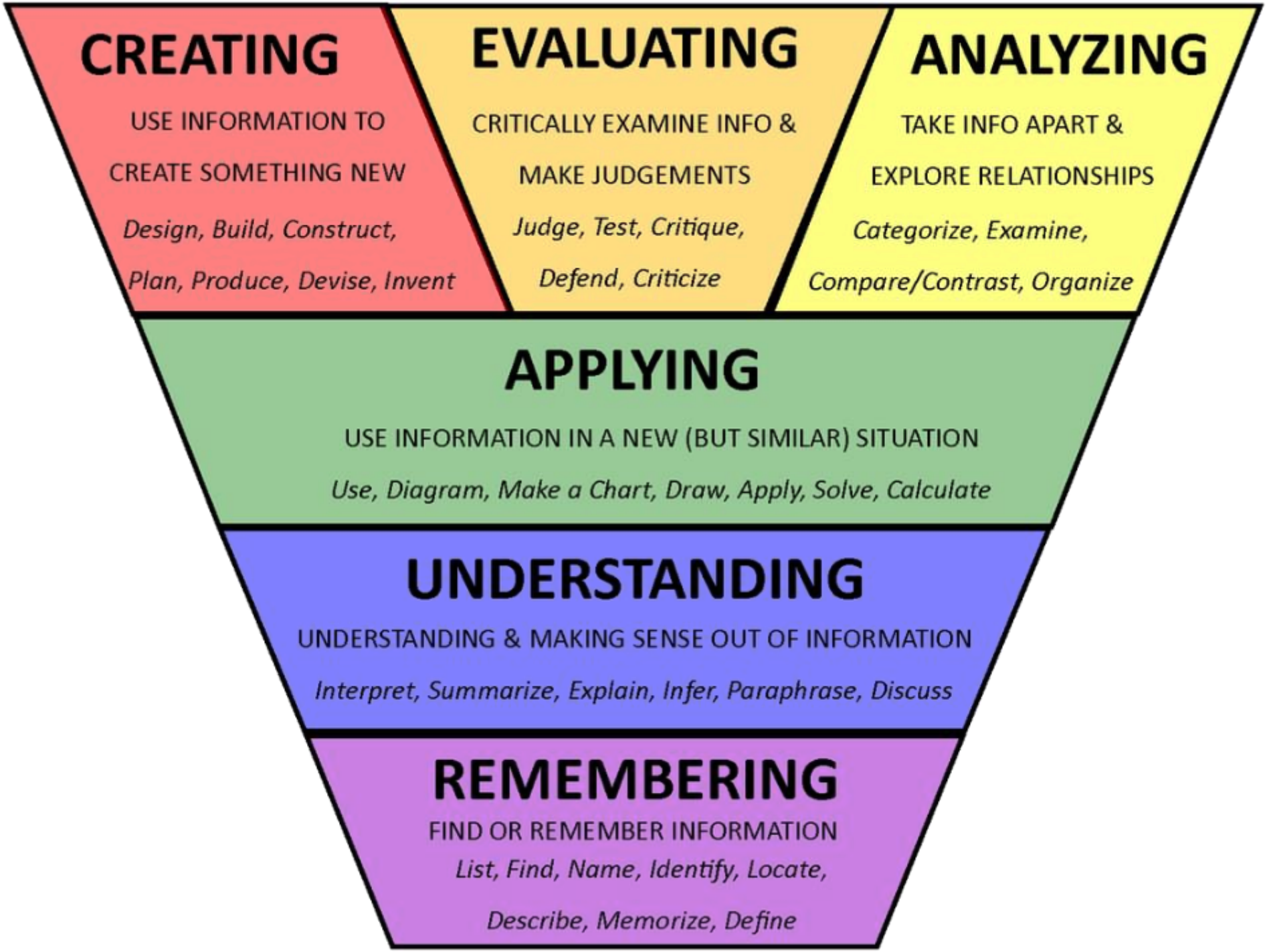
and toward

- Monitoring inquiry
- Coach and facilitator

- Students move away from
  - Listening/watching
  - Dependence
  - *Gaining* knowledge

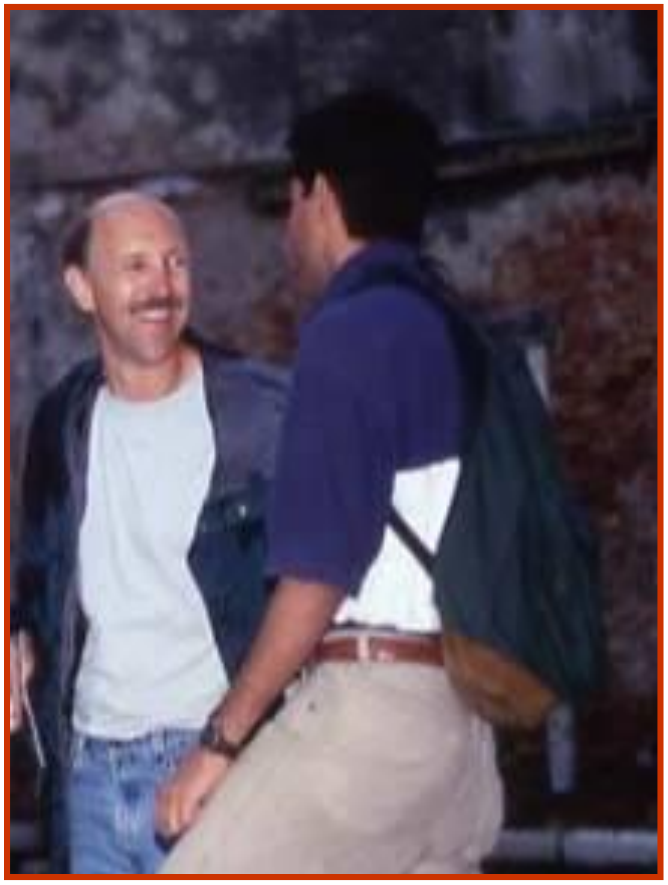
and toward

- Creating/discovering
- Independence
- *Making* knowledge


CREATING
USE INFORMATION TO CREATE SOMETHING NEW
Design, Build, Construct, Plan, Produce, Devise, Invent
EVALUATING
CRITICALLY EXAMINE INFO & MAKE JUDGEMENTS
Judge, Test, Critique, Defend, Criticize
ANALYZING
TAKE INFO APART & EXPLORE RELATIONSHIPS
Categorize, Examine, Compare/Contrast, Organize
APPLYING
USE INFORMATION IN A NEW (BUT SIMILAR) SITUATION
Use, Diagram, Make a Chart, Draw, Apply, Solve, Calculate
UNDERSTANDING
UNDERSTANDING & MAKING SENSE OUT OF INFORMATION
Interpret, Summarize, Explain, Infer, Paraphrase, Discuss
REMEMBERING
FIND OR REMEMBER INFORMATION
List, Find, Name, Identify, Locate, Describe, Memorize, Define

How Are Project Students Evaluated?

- Quality of *results*
  - Careful research
  - Valid analysis
  - Persuasive arguments
  - Responsive solutions
  - Awareness of limitations
- Quality of *process*
  - Steadiness of effort
  - Interactions with others
  - Written and verbal communication
  - Timeliness and professionalism



Faculty Roles in Project Work

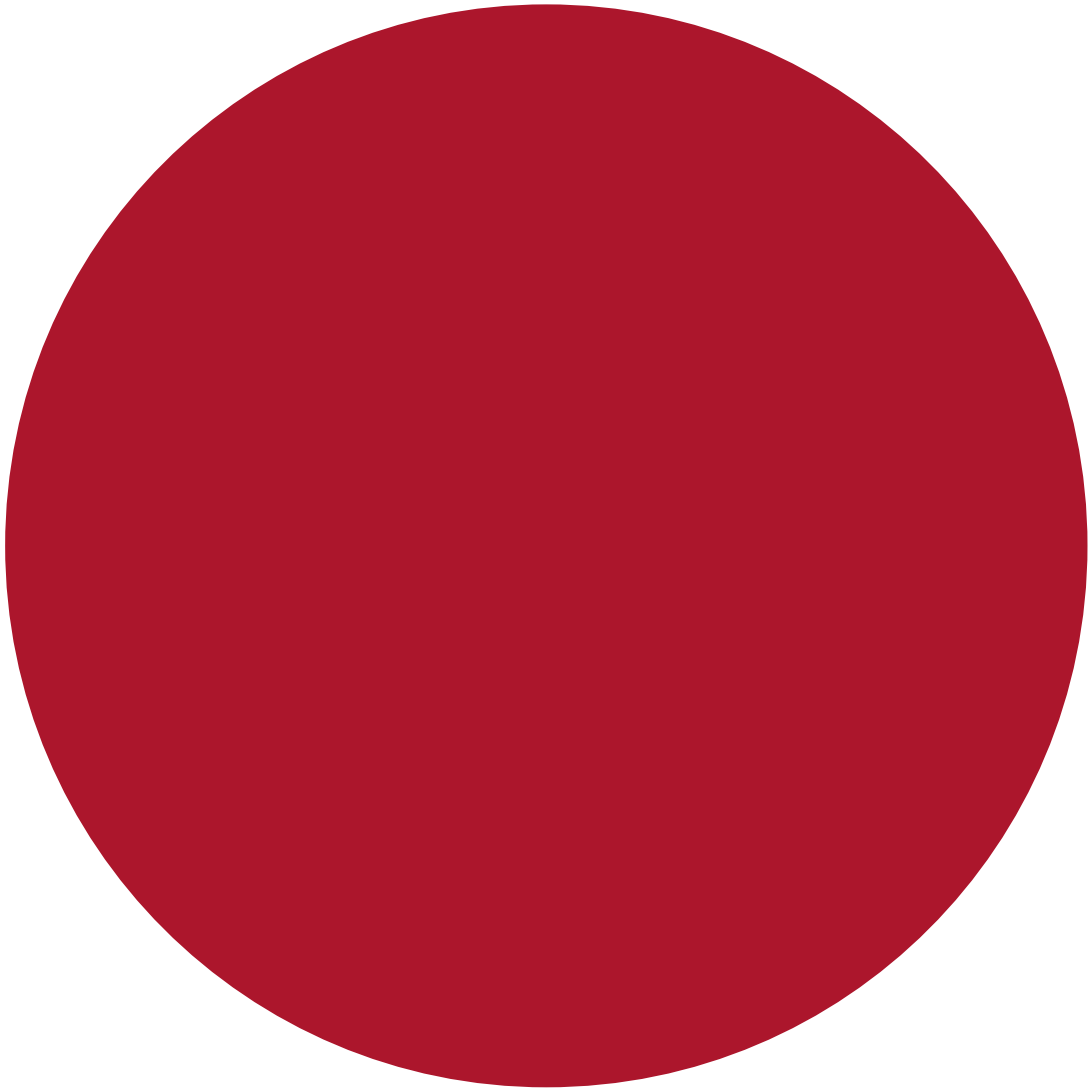
- Identifying project topics
- Designing the experience
  - Interim assignments
  - Meetings with students
  - Feedback on assignments and revisions
  - Evaluating results and process
- Less traditional roles
  - Logistical arrangements
  - Coaching, mentoring
  - Managing relationships with organizations

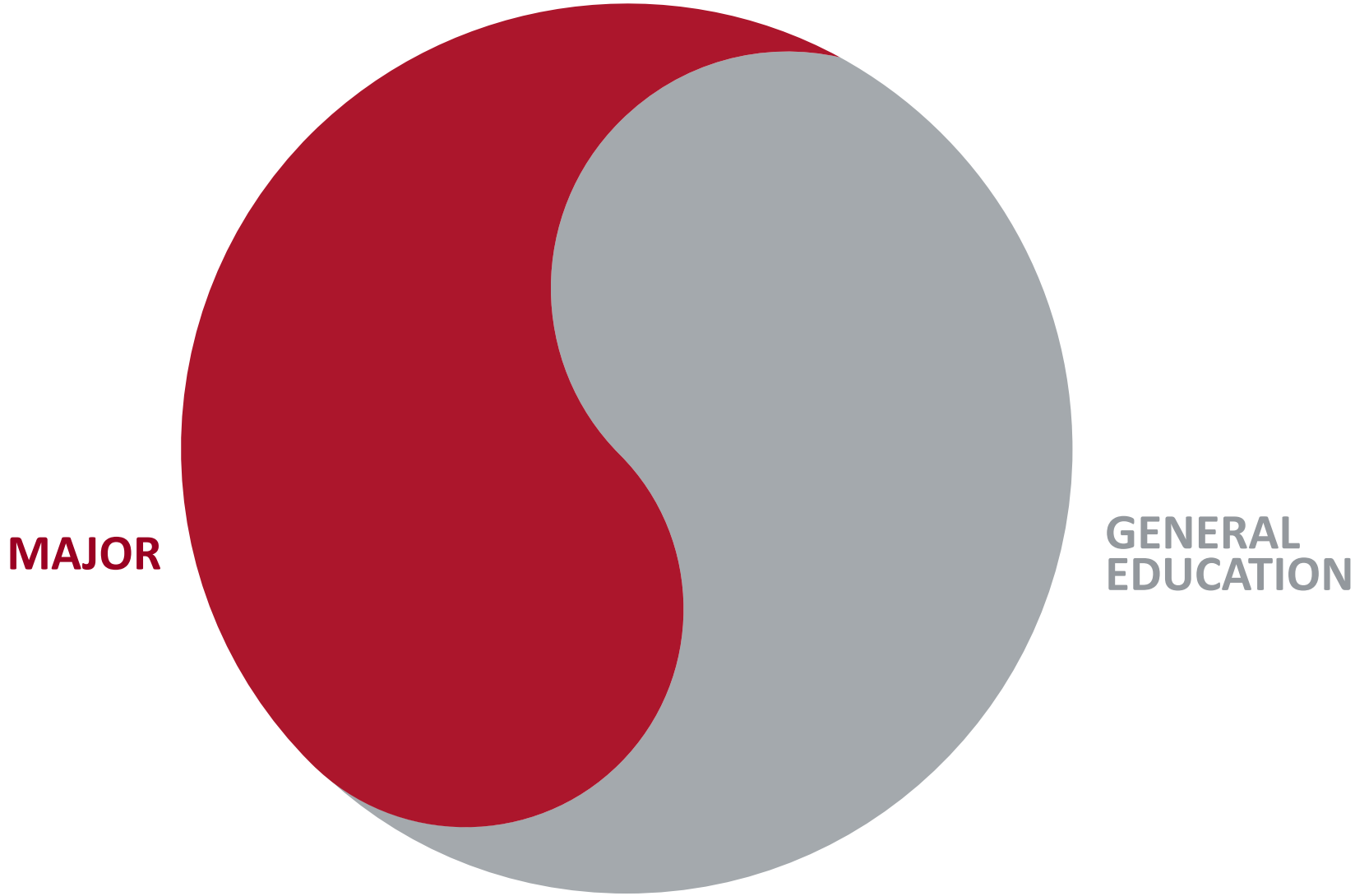
Institutional Impacts of PBL

- Student learning and attitudes
  - transferrable skills and abilities
  - confidence, self-efficacy
- Faculty culture
  - shift of focus toward learning
  - opportunities to collaborate
- Community and academic partners
  - mutual benefits
  - sustainable relationships
- Opportunities for advancement, marketing

Other Benefits

- Rich accreditation evidence
  - Ability to apply knowledge
- Faculty professional development
  - Powerful experiences, attractive opportunities
- Multidisciplinary collaboration
  - Team teaching leads to other partnerships

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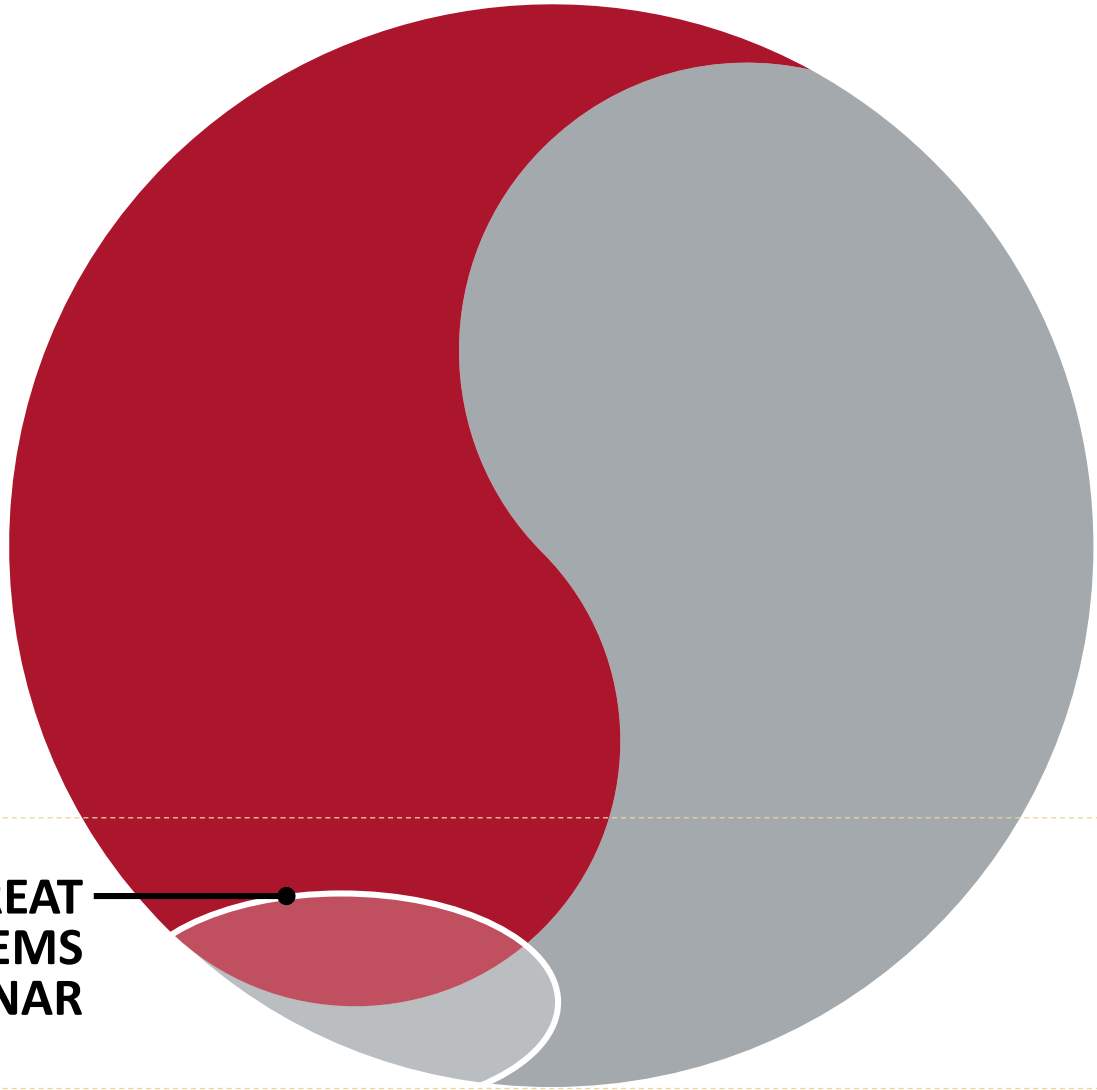

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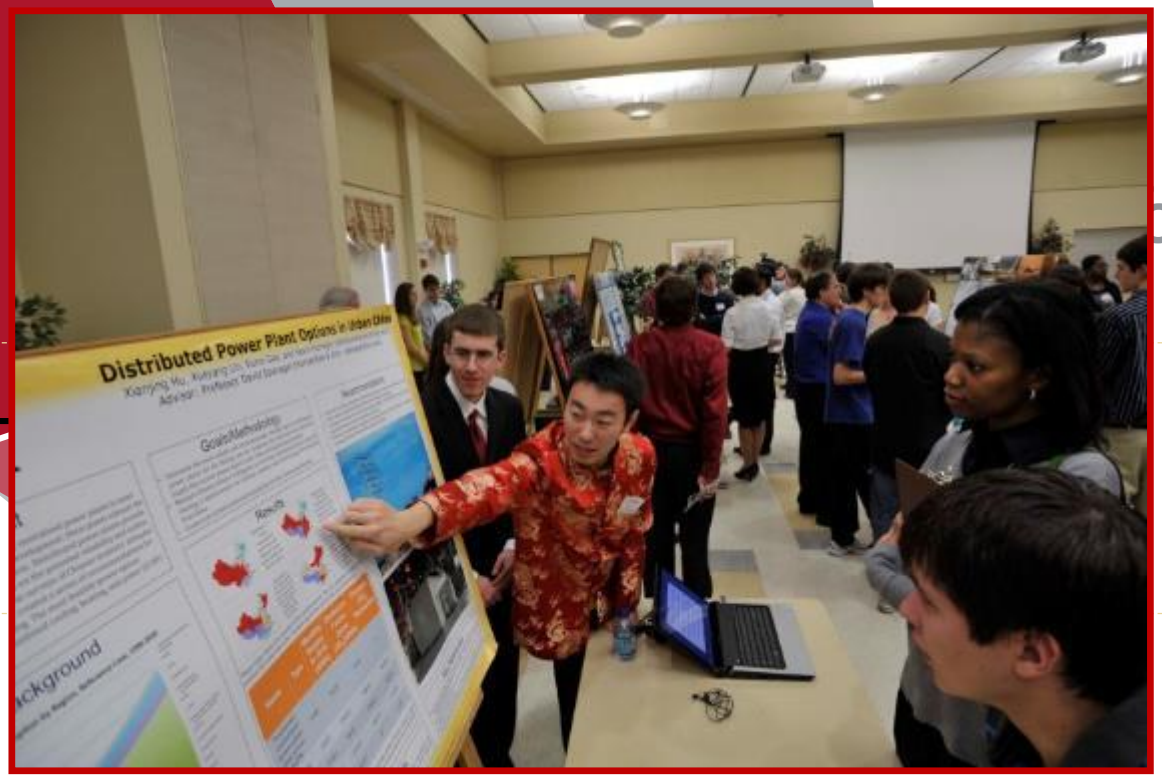

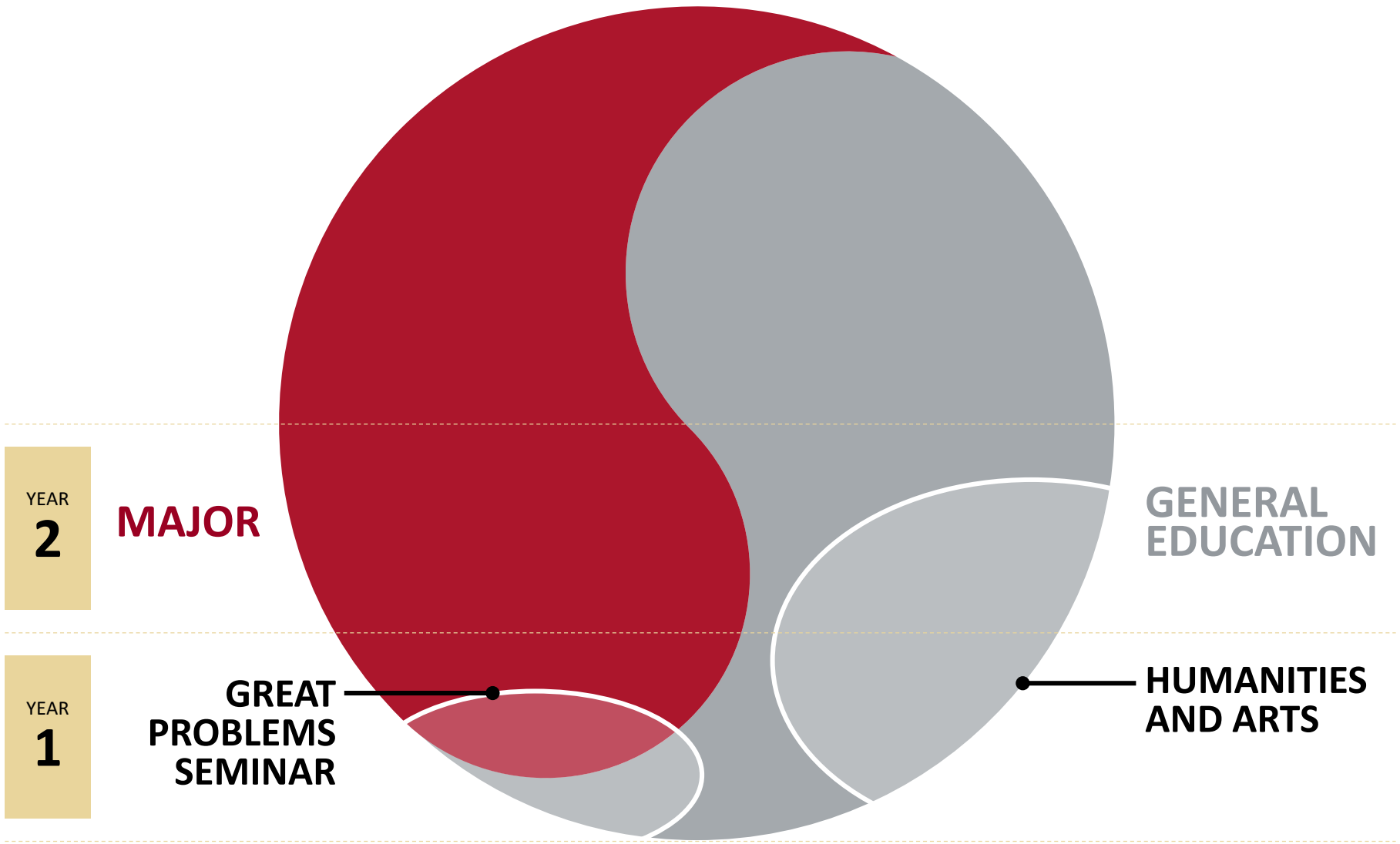
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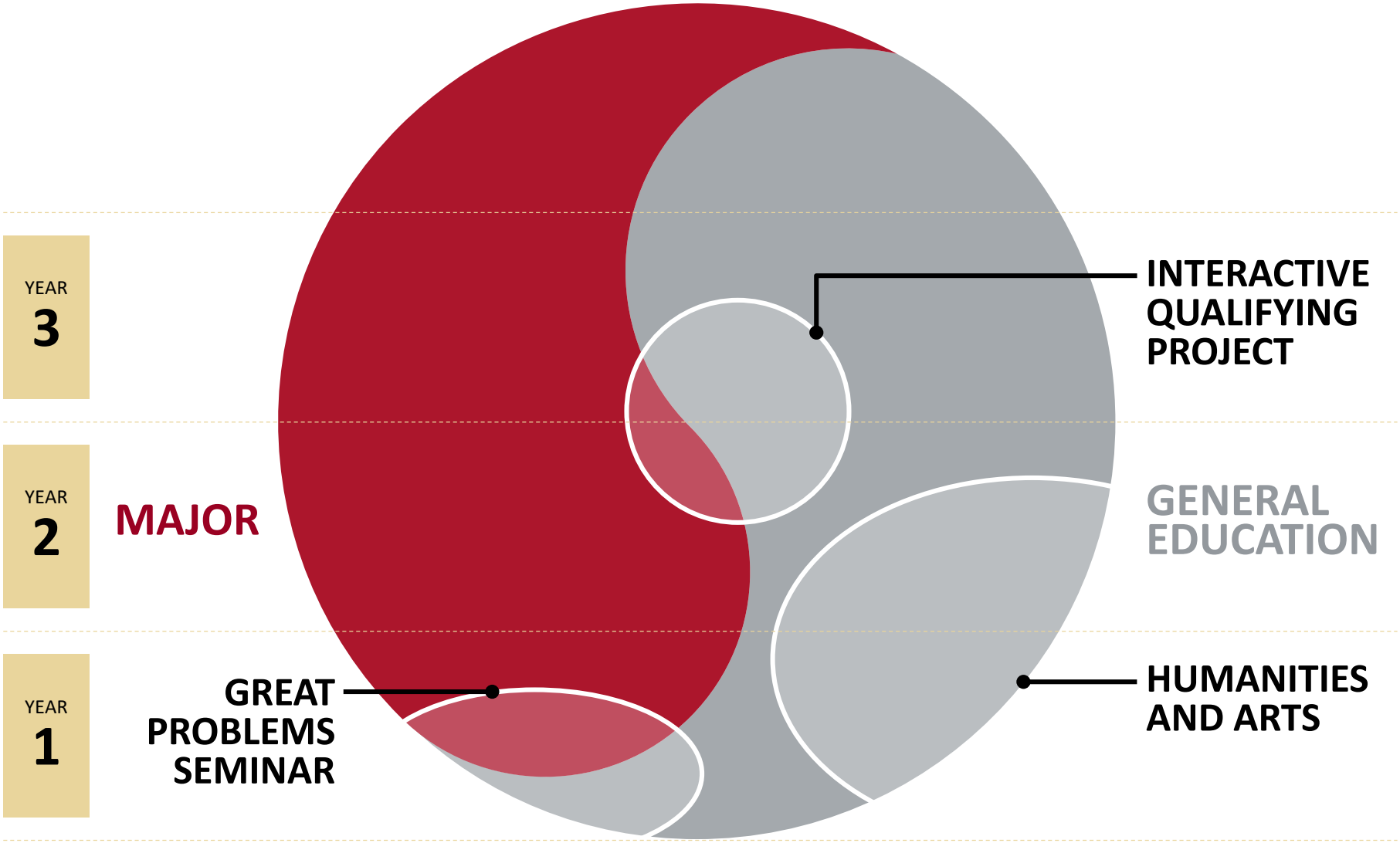
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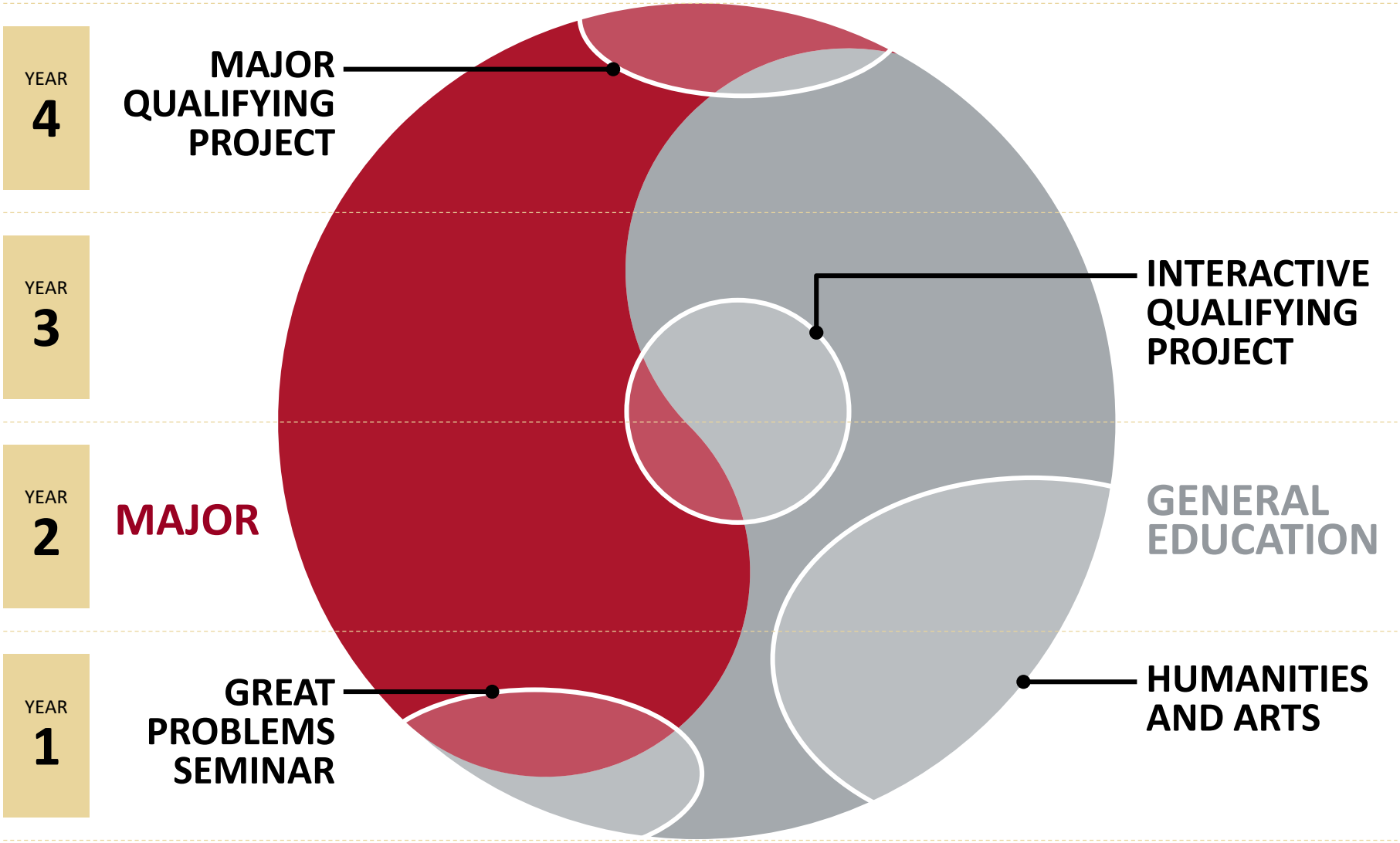
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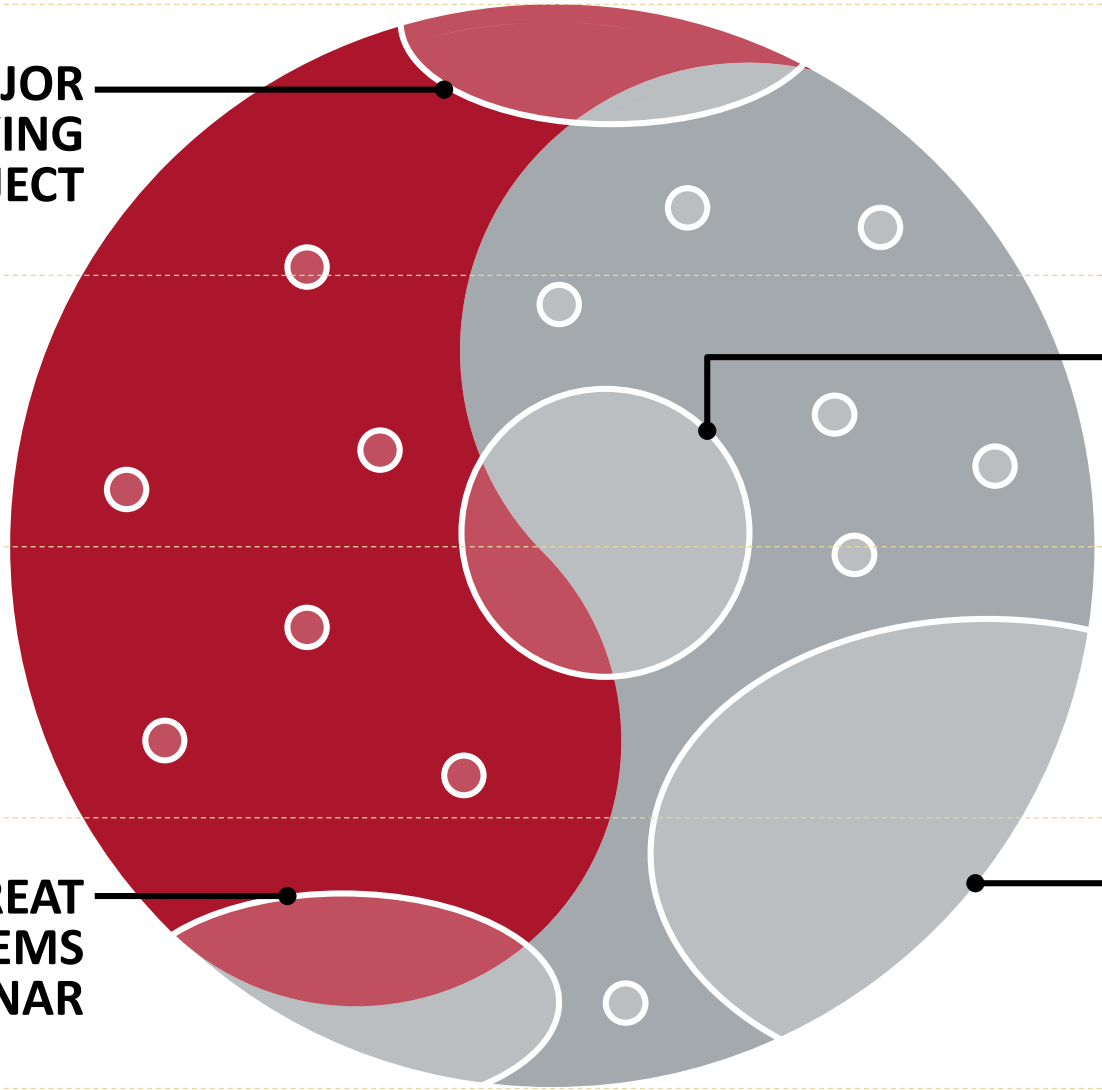

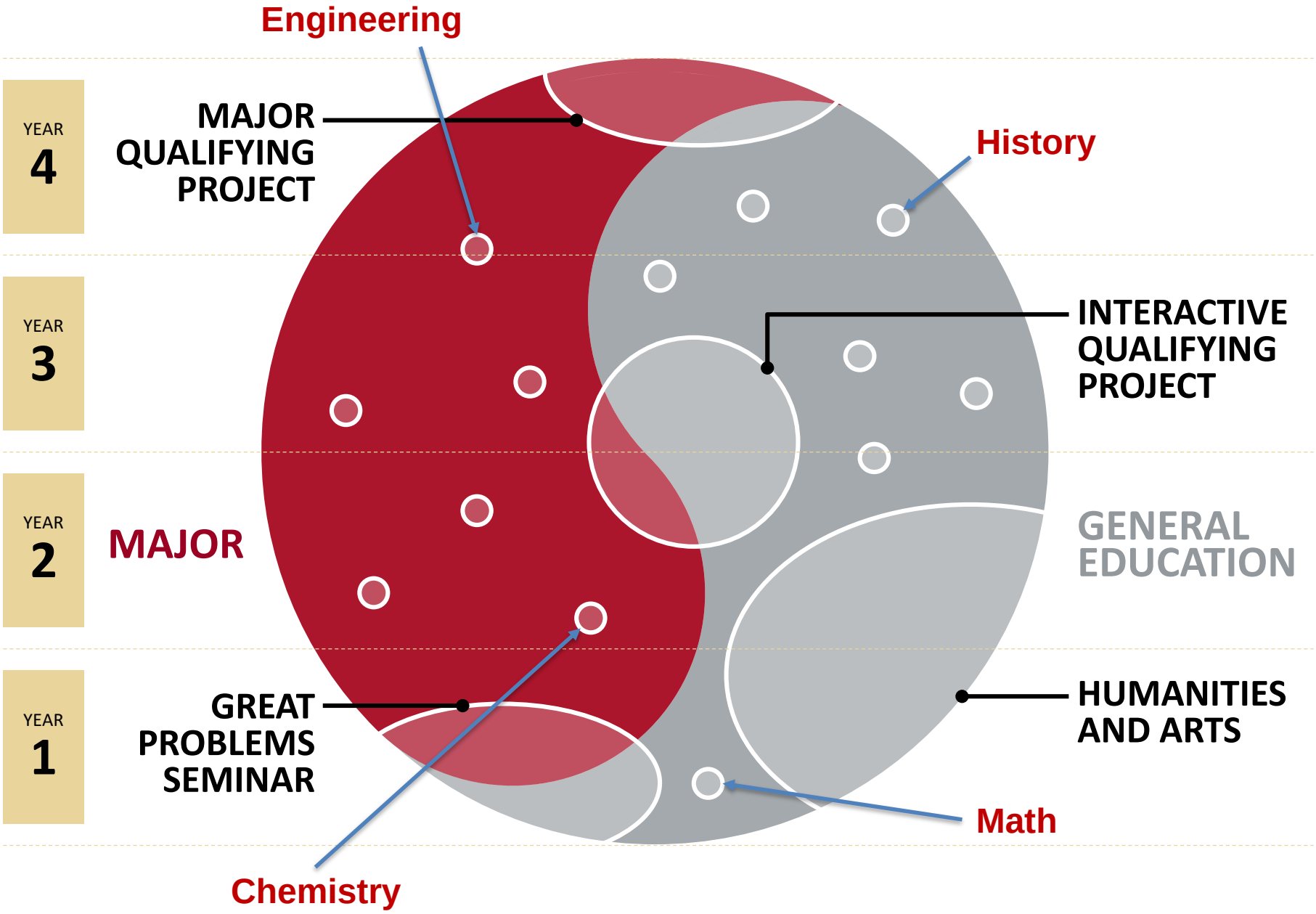
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History
YEAR 3
INTERACTIVE QUALIFYING PROJECT
YEAR 2
MAJOR
GENERAL EDUCATION
YEAR 1
GREAT PROBLEMS SEMINAR
HUMANITIES AND ARTS
Math
Chemistry

Authentic (Situated) Projects

- Makes the problem/issue concrete
  - Illuminates causes/consequences
  - Work with real data
  - Draw on real experts
- Makes the problem/issue engaging
  - Real people impacted
  - Provides motivation
  - Opportunities for feedback
- Demands a practical answer
  - Reality-based
  - Acceptable to stakeholders

Examples of Authentic Projects

- Design of Community Gardens
  - Working with a local non-profit, students designed community gardens and developed a plan for their maintenance
- Boutique Marketing Plan
  - Working with a local bridal consignment shop, students conducted a market analysis and developed a marketing strategy and materials for the shop
- Promoting Sustainable Transportation
  - Working with multiple campus groups, students developed a successful proposal to implement a bike share on campus
- Franchising Plan for Mobile Tutoring Services
  - Working with a Kenyan entrepreneur, students developed a franchising model and business plan to address unmet educational needs in Africa

Projects in Courses: Biochemistry

- Pet Enzyme Project
  Student teams produce reports on an assigned enzyme, paralleling course content
  - Protein structure: online prediction and visualization tools
  - Catalytic mechanisms/kinetics: ditto
  - Metabolic pathways: enzyme regulation and research rationalization
- Brings the theoretical into the practical
- Links what can appear to be disparate concepts
- Utilizes tools available to professionals
- Makes things memorable!

Assessment Results

Area of Impact	Percentage Responding Positively (N=86)
Literature searching and search strategies	87
What biochemists do	79
Why we study the material in Biochem I	64
Working in groups	66
Scientific writing	53
Nothing	1

Projects in Courses: Engineering Design

- Team-taught, sophomore level
- Faculty "managers" offer design challenges posed by external clients
- 8-10 design teams of 3 students address each challenge
- Design teams mentored by undergrad "senior engineers"
- Course covers design *process* and *principles*
- Student teams do technical design on their own
- Weekly design reviews and reports
- Working prototype expected

Sample Results

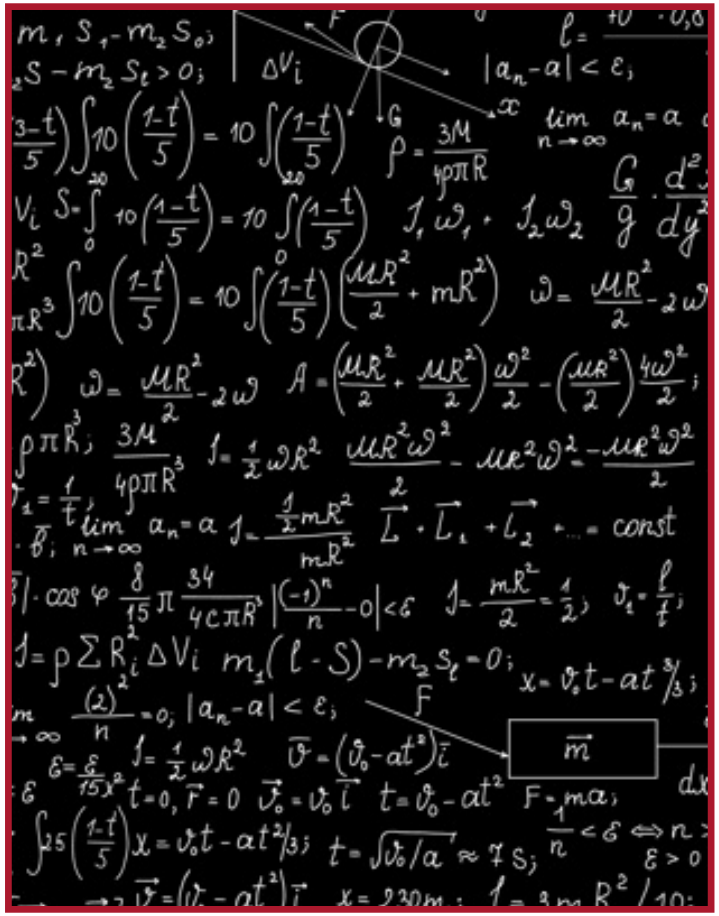
- 18 designs, all responsive to user needs
- 100% course retention rate
- 76% of students reported over 20 hpw on task
- 93% agree “solidified understanding”
- 96% agreed “learned to apply previous knowledge”
- 20% volunteered to continue the work after the course

Projects in Courses: Materials Science

Recommend and justify a material for the rod rigging of a racing yacht, to reduce its weight

- Fictitious client, realistic scenario
- Open-ended with multiple solutions: some constraints given, students must investigate others
- Deliverable: technical memo
- Detailed rubric to communicate expectations
- Students assigned to teams that work together throughout course: self and peer evaluation
- Formative feedback before submission: check-ins during class

Projects in Courses: Mathematics



- Differential Equations: Modeling dynamic systems (mechanical, electrical, hydraulic)
- Linear Algebra: Using population models to predict the sustainability of the New England fishing industry using publicly available data and different assumptions

Windhoek Project Center

- ~400 students on ~100 projects since 2003
- Collaboration with Polytechnic of Namibia
- NGO, municipal, and nonprofit sponsors

- Water management
- Community development
- Renewable energy
- Sustainable tourism

Examples of Windhoek Projects and Sponsors

- Wildlife protection (Cheetah Conservation Foundation)
- Capacity building (Namibia Housing Action Group, Shack Dwellers Foundation)

- Tourism development (City of Windhoek Tourism)
- Water resource management (Desert Research Foundation)

Sponsor: Cheetah Conservation Fund

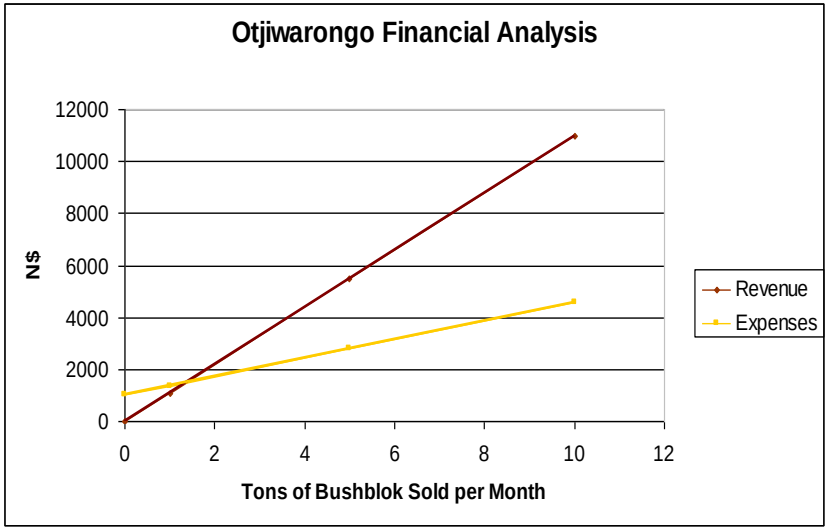
Project Objectives

- Identify Namibian markets for Bushblok
- Evaluate technological and social implications
- Focus on firewood markets in the residential sector and heating applications in the industrial sector

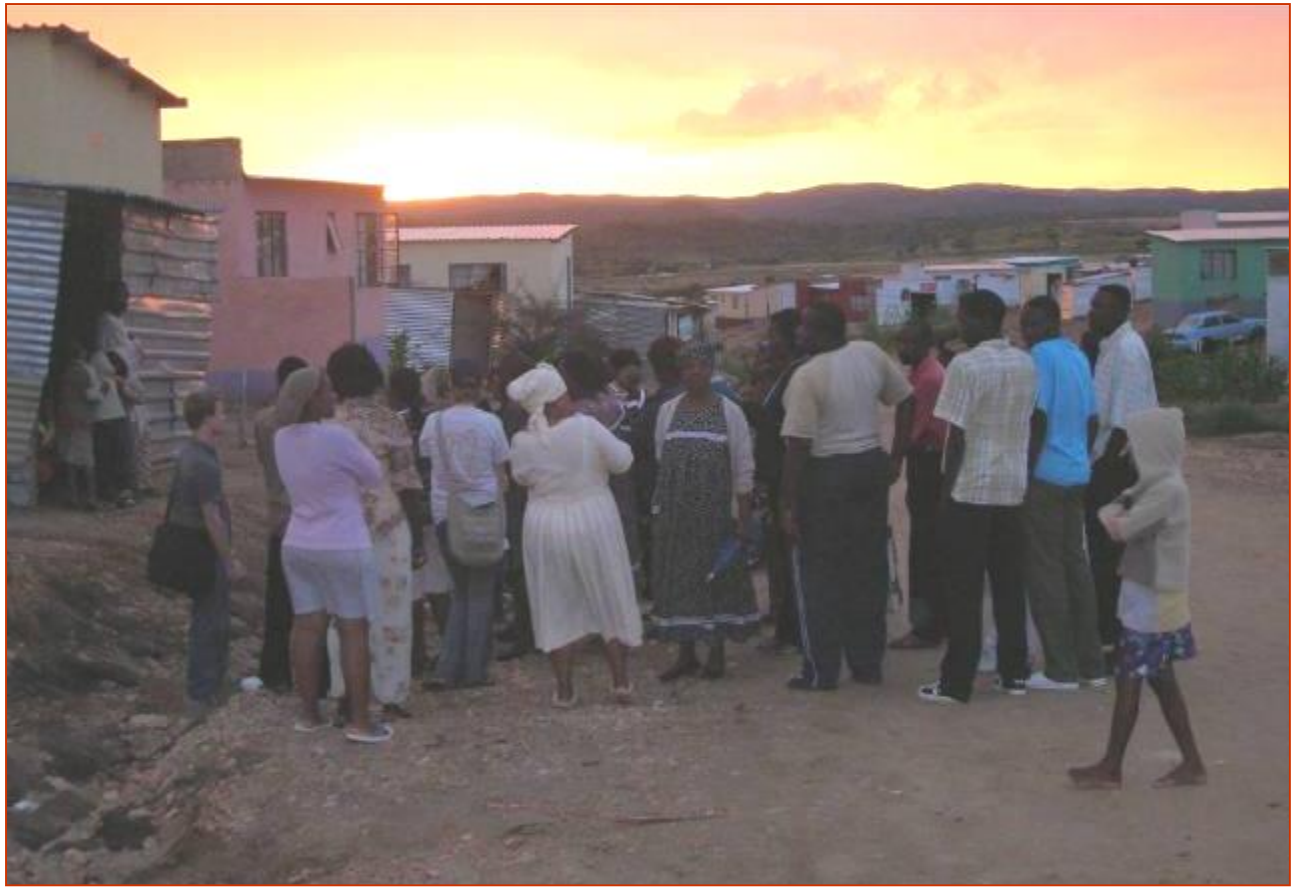
- Make recommendations to CCF Bush Pty. Ltd.
- Present framework for a business plan

Results

- Co-firing with coal may be feasible in the future
- Residential demand strong now
- Wood scarce, expensive in North Central Region



Erosion and Flood Control in Otjomuise



Sponsors: Namibia Housing Action Group, Shack Dwellers Federation

Project Objectives

- Work with community to identify flooding and erosion problems and solutions
- Facilitate implementation of demonstration solutions by community residents

- Promote capacity for participatory problem solving
- Achieve broader impact through dissemination of ideas and methods

Results

- Problems and solutions identified by community members
- Four flood/erosion control projects implemented with community
- Twelve additional projects implemented by community

- Evidence of capacity building and knowledge sharing
- English/Afrikaans/pictorial pamphlet developed for broader dissemination


Thank You