MESA: Making an impact on STEM education

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Nevada STEM Smart Meeting

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What is MESA?

- Mathematics, Engineering, Science Achievement
- Started in 1970 as an inter-segmental program, administered through the California Public School System, Community College System, and California College System.
- Currently nine states have MESA programs: Arizona, California, Colorado, Maryland, New Mexico, Oregon, Pennsylvania, Utah and Washington

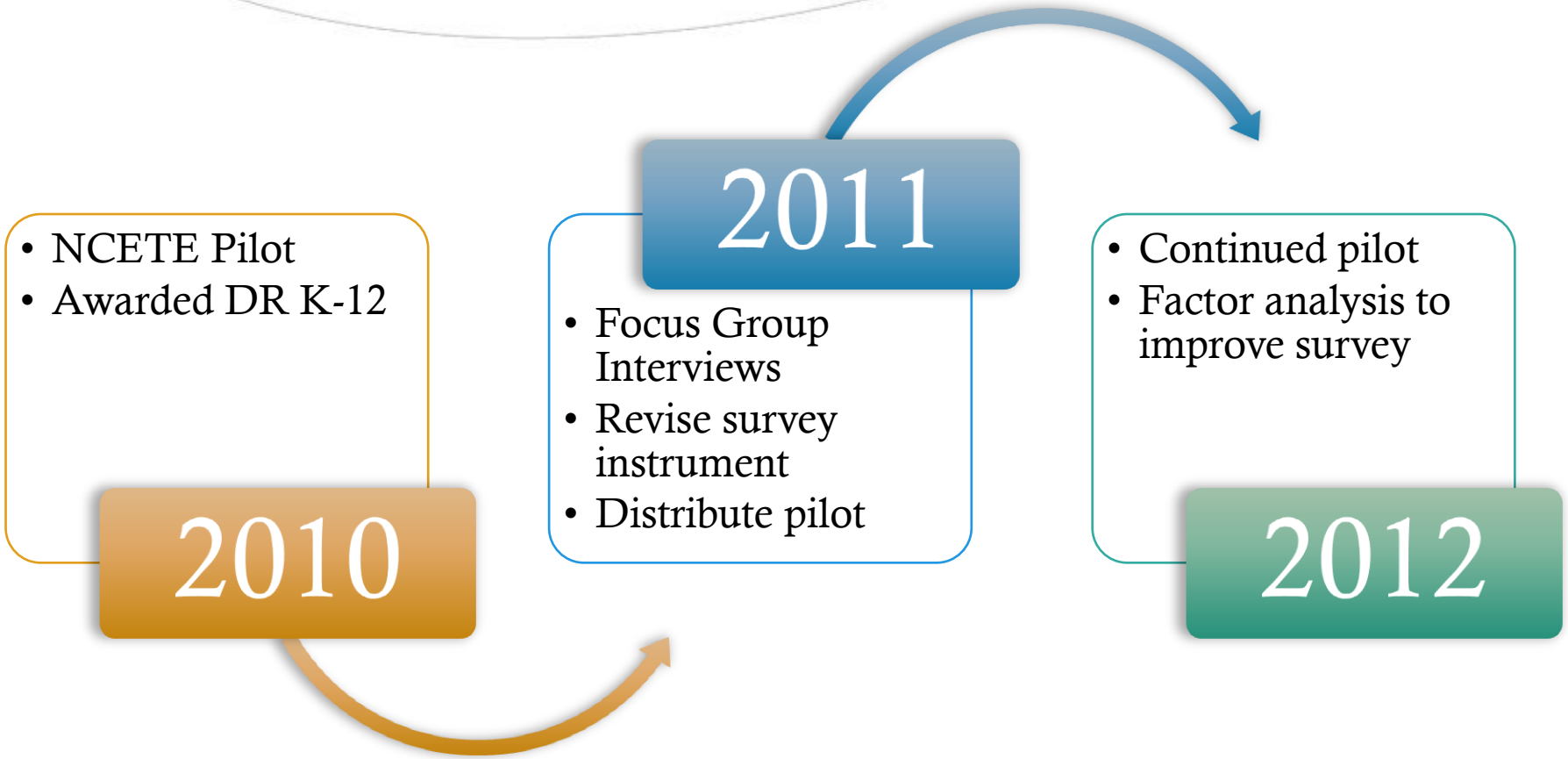
Why MESA

- Forty-Two Years of experience
- Co-curricular and Extra curricular programs
- Different levels of MESA: Middle school, High school, Community college, and 4-year colleges.
- Focuses on different paradigms
  - SAT/ACT preparation, study skills training, hands-on activities, competitions, career and college exploration through field trips and guest speakers, parent leadership development, individual academic plans, and teacher training opportunities

Background of Leadership Team

- Christine Hailey, PI, Senior Associate Dean, Utah State University
- Chandra Austin, Co-PI, Postdoctoral Teaching Fellow, Auburn University
- Cameron Denson, Co-PI, Assistant Professor, North Carolina State University

Work we have done with MESA



NCETE Pilot

- The researchers capitalized on their backgrounds to develop a survey instrument. They also used components from pre-existing surveys.
  - field trips, guest lecturers, design competitions, hands-on activities, and career and academic advisement.
- Worked with California MESA and Utah MESA for initial pilot
- Collected ~170 surveys

DR K-12

"Influence of MESA Activities on Underrepresented Students"

- In order to strengthen the nation's effort to attract a more diverse talent pool and to build upon the outreach efforts of programs like MESA, the project will study activities within engineering enrichment programs that have an influence on underrepresented students. It is anticipated that those effects might also be applicable to the programs of other national outreach organizations with a focus on engineering, including JETS, SECME, Inc., and TSA, as well as to the countless local outreach programs. The results of this study may also have implications for improving standards-based instruction in the STEM disciplines.

Focus Group Interviews

- 28 participants from 5 different schools throughout California
- Students were interviewed for approximately one hour
- Two interview questions;
  - (1) Can you describe one of the best times you have had in MESA?
  - (2) What do you think you are gaining by participating in MESA?
- Focus group responses produced eight disparate themes: (a) provides informal mentoring, (b) makes learning fun (c) improves time management (d) applies math and science, (e) enhances feelings of accomplishment, (f) builds confidence, (g) strengthens camaraderie, and (h) provides exposure to new opportunities.

Revision of instrument

- Resulting factor analysis of NCETE pilot
- Met with our Advisory Committee Chair, Dr. Francis Lawrenz
- Need to “create activity components”
- Focus Group interviews used to unpack activity variables

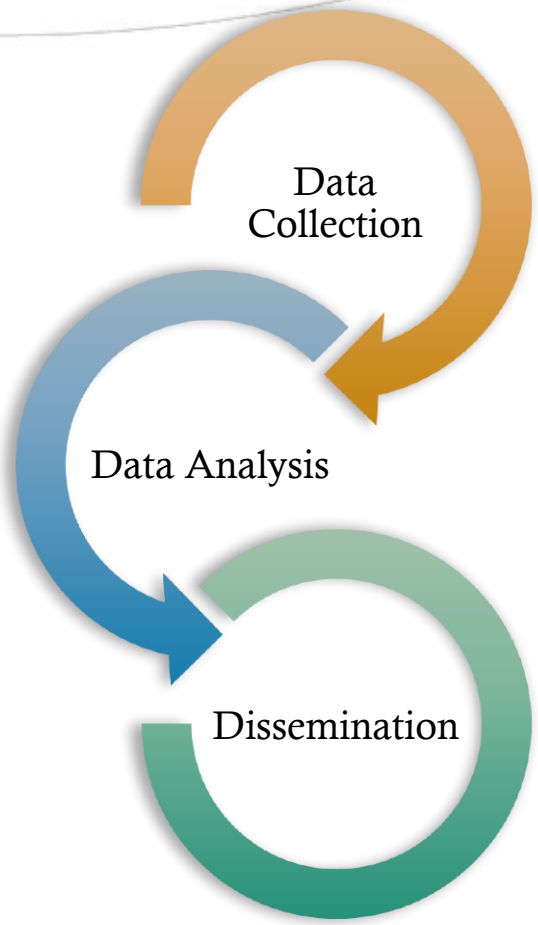
MESA pilot study

- Included Washington MESA
- Received about ~165 responses

Factor Analysis

- Reduction of items

Next steps in working with MESA



Questions?

Acknowledgements

- This work would not have been possible without the help of MESA State Director and Teachers in California, Washington, and Utah.

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Parachute Activity

- Example of a MESA activity

- Since MESA teachers can be science teachers, math teachers, pre-engineering teachers, or counselors MESA tries to be diverse in the concepts covered in their activities.

Sample Class Lesson

Preparation Activity

Challenge

- Using the materials provided, construct a landing device that will safely allow the re-entry of astronauts into the Earth's atmosphere.

- Key concepts: gravity, free fall, acceleration, air resistance, Newton's Second Law

Warm-up exercise

- How do we stop an object in free-fall?
- What is terminal velocity?
- http://www.physicsclassroom.com/mmedia/newtlaws/efar.cfm

All About Parachutes

- First parachute was a variation of an umbrella developed by the Chinese to entertain guests at court ceremonials.
- A parachute is an umbrella-shaped device of light fabric used especially for making a safe jump from aircraft.
- What materials do you think work best for a parachute?

What A Drag

- Due to the resistance of air, a drag force acts on a falling body (parachute) to slow down its motion.

- Without air resistance, or drag, objects would continue to increase speed until they hit the ground.

Air resistance

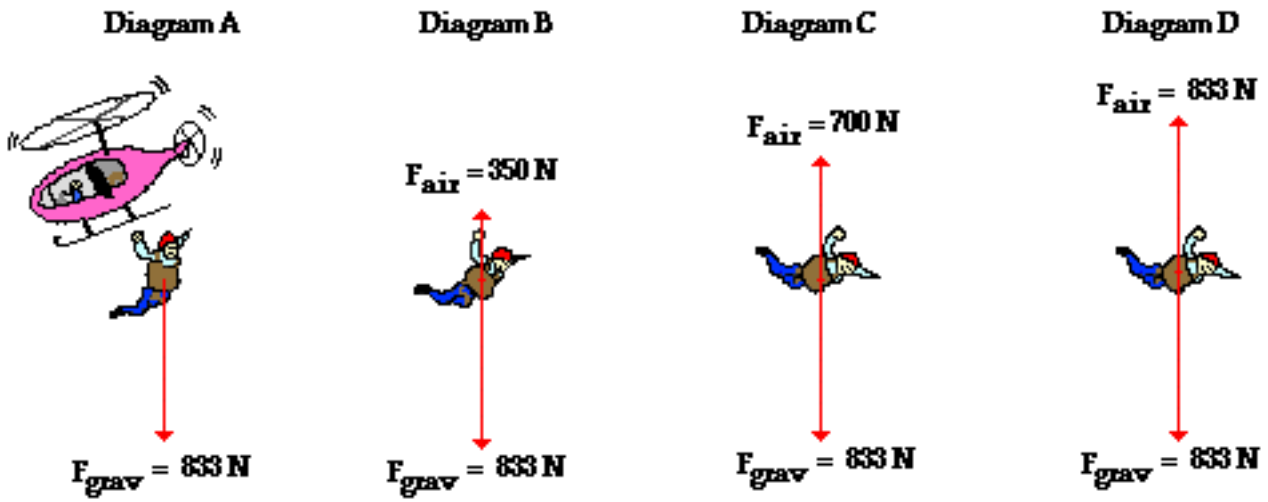
- The larger the object, the greater its air resistance. Parachutes use a large canopy to increase air resistance. This gives a slow fall and a soft landing.

Newton's 2nd Law

- $F_{net} = m * a$

- **Not considering air resistance, objects on Earth fall at a rate of gravitational acceleration equal to 9.8 meters per second squared.**

Free fall quiz



In the diagrams above free-body diagrams showing the forces acting upon an 85-kg skydiver (equipment included) are shown. For each case, use the diagrams to determine the net force and acceleration of the skydiver at each instant in time.

In-class work

- Divide into groups of four
- The entire activity should take about 60 minutes but we are going to do the hands-on part
- In class as listed on the sheet you can do: 30 minutes for design, 30 minutes for testing, and if you want to assign out of class work they recommend a journaling activity.