

# Southwestern United States CO<sub>2</sub> Sequestration Training Center (CO<sub>2</sub>TC)

## Project Summary

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*with*

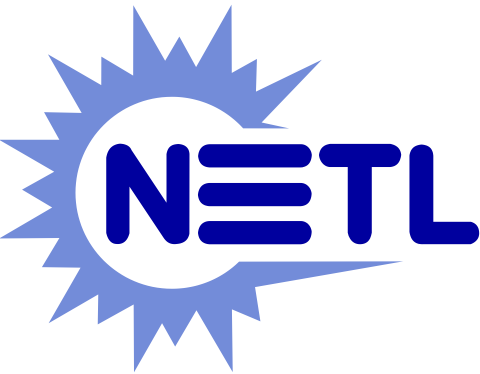
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# Southwestern United States

## CO<sub>2</sub> Sequestration Training Center (CO<sub>2</sub>TC)

### Acknowledgements:



**Many thanks to the U.S.  
Department of Energy and  
the National Energy  
Technology Laboratory for  
All Forms of Support**

# Southwestern Training Center (CO<sub>2</sub>TC)

- The principal objective of the project is to increase the number of professionals pursuing careers in geological carbon sequestration
- Our overall approach is to generate early interest, develop academic programs, implement continuing education for professional development, and promote public awareness.

# Three Tiers of Training

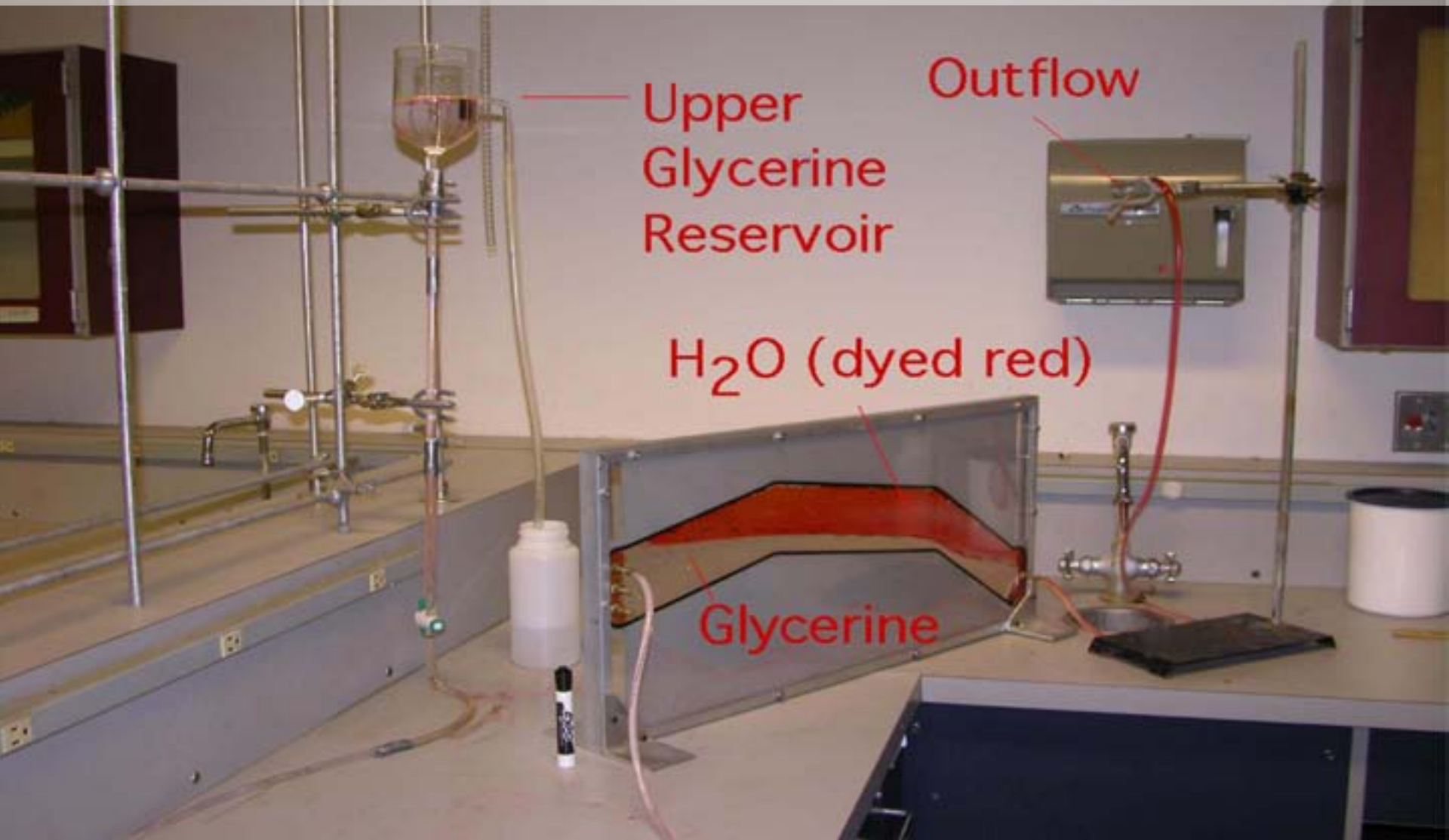
- ***1st Tier: Secondary School CCS Education and Training***
- ***2nd Tier: University CCS Education and Training***
- ***3rd Tier: Professional CCS Education and Training***

# 1st Tier: Secondary School Education

1. *Develop CCS teaching modules for jr. high and high school science classes*
2. *Summer high school CCS mini-course*
3. *Master of science teaching CCS course for high school teachers*

# 1st Tier: Secondary School Education

## 1. Example CCS Teaching Module for High School



# *1st Tier: Secondary School Education*

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## *2. Summer high school CCS mini-course:*

- To introduce CCS as a viable career option for earth scientists.
- Offered to high school students throughout New Mexico (for university credit).
- Will instruct basic geology and concepts of CO<sub>2</sub> sequestration.
- Will include both lecture and lab components

# *1st Tier: Secondary School Education*

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## *3. Master of Science Teaching Course (for teachers):*

- Will educate secondary science teachers in CCS.
- Offered during summers.
- Will include same topics as senior course but at a level that the teachers can take back to their high schools.

## *2nd Tier: University Education*

- 1. College Senior-Level (4000) CCS Course*
- 2. Earth Science undergraduate specialization - perhaps eventually a minor - in Carbon Science*
- 3. Graduate-Level (7000) CCS Course*

# *2nd Tier: University Education*

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## *1. College Senior-Level (4000) CCS Course:*

- Carbon Science - basics of:
  - drivers of CCS (climate change, etc.)
  - anthropogenic CO<sub>2</sub> sources
  - all forms of sequestration
  - focus on scientific processes
- Local field component - will take advantage of abundant local outcrops
- Will include specialty lectures by CCS researchers at NMT, Los Alamos National Lab, and Sandia National Labs



NMT students examining high permeability fluvial sands and gravels with interbedded mud layers (Sierra Ladrones Fm near Socorro, NM)

# 2nd Tier: University Education

## 2. Earth Science Specialization

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*(goal: a formal minor)*

- will include core Earth science courses required for all majors
- will also include additional courses in:
  - math
  - geology
  - chemistry
  - hydrology
  - petroleum engineering
  - basin analysis
  - geophysics

# *2nd Tier: University Education*

## *3. Graduate-Level (7000) CCS Course*

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- This course will be the “capstone” of the university education program (2nd tier)
  
- This course will be advanced and comprehensive, with intense review of all aspects of CCS - “cradle to grave”

# 2nd Tier: University Education

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## 3. Graduate-Level (7000) CCS Course

- This course will be advanced and comprehensive, with intense review of all aspects of CCS - “cradle to grave” :
  - global carbon cycle
  - global climate change and the Keeling curve
  - natural vs. anthropogenic CO<sub>2</sub> sources
  - natural vs. anthropogenic CO<sub>2</sub> sinks
  - all forms of sequestration
  - advanced treatment of MVA
  - advanced treatment of capacity methods
  - advanced treatment of risk assessment

# *2nd Tier: University Education*

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## *3. Graduate-Level (7000) CCS Course*

- Joint-effort among NMT, the University of Utah, and Texas A&M

# *2nd Tier: University Education*

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- Offered at all three universities simultaneously, with each university offering specific portions of the course

# 2nd Tier: University Education

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- Joint-effort among NMT, the University of Utah, and Texas A&M
- Offered at all three universities simultaneously, with each university offering specific portions of the course
- Offered in-person for students on those campuses, BUT:

# 2nd Tier: University Education

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## 3. Graduate-Level (7000) CCS Course

- Joint-effort among NMT, the University of Utah, and Texas A&M
- Offered at all three universities simultaneously, with each university offering specific portions of the course
- Offered in-person for students on those campuses, BUT:
- **Class time will be “live” for 1 school, and online/webinar for the other 2 schools (as well as a distance education option in all states in the region)**

# *2nd Tier: University Education*

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## *3. Graduate-Level (7000) CCS Course*

Materials from this course will serve as the primary source of information for the 3rd tier (Professional CCS Education and Training)

# 3rd Tier: Professional Training

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1. *Half-day short course and online webinar*
2. *Multi-day short course*
3. *Accredited Continuing Education Units (CEUs)*

# 3rd Tier: Professional Training

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- *1. Half-day short course and online webinar* Based on graduate course, the “critical” elements will be taught in a half-day course
- Offered during selected regional and national meetings
- A webinar version of this half-day course will be developed and offered periodically
- For each iteration of the “live” short course, the webinar version will be updated

# 3rd Tier: Professional Training

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## 2. Multi-day short course

- Also based on graduate course, “critical” elements will be taught in a multi-day short course
- A field trip will be conducted as a means of demonstrating most to all elements of the course
- Offered once annually, possibly in tandem with a regional or national meeting

# 3rd Tier: Professional Training

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## 3. Accredited Continuing Education Units

- The 1/2-day short course, multi-day short course, and all webinars will be accredited with appropriate CEUs

(or "Professional Development Units," PDUs, as appropriate)

- We just began the accreditation process with all three universities

# Program Continuity

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*What will happen when the official period of performance ends?*

*We plan to continue the CO<sub>2</sub>TC indefinitely, facilitated by effective marketing and sustained by appropriate fees/tuition.*

# Program Continuity and Oversight

## Advisory Board

- Marketing Strategy
- Business Plan/Model
- Financials

Activities (text color)

- |   |   |
|---|---|
| <span style="color: green;">■</span> 1  | <span style="color: gray;">■</span> 2 & 3       |
| <span style="color: red;">■</span> 4    | <span style="color: orange;">■</span> 1 & 5     |
| <span style="color: purple;">■</span> 5 | <span style="color: black;">■</span> Objectives |

### • Marketing

- Develop CCS educ. materials per state-specific curriculum standards
- **Will generate early interest and knowledge about CCS**

### • Marketing

- Distance Learning targeted to wide audience:
  - MBA: business
  - Law: regulatory
  - Humanities: communication & public
  - Behaviorial Science: policy
  - Education: K-12, college
  - Comp. Sci: modeling

### • Marketing

- Short courses for CCS that will provide CEU's to K-12 teachers
- **Will provide education and training tools for classroom use**

### • Marketing • Newsletters

- WWW site
- Short courses for PDU's
- Working group with other training programs
- **Will provide current technical info, training, funding opportunities, and networking**

### • Marketing • Newsletters

- WWW site
- Materials via website
- **Will provide general CCS info about projects, workshops, and activities within the region**

K-12  
Students

Ungrad.  
Students

Grad.  
Students

Teachers  
CEU

Industry/  
Professionals

General  
Public/Media

Thanks for your  
attention!

# The Benefits of Games

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- Energizes a teaching environment
- Introduces and reinforces concepts
- Promotes collaboration
- Allows for mistakes and turns them into a learning experience
- Appeals to kinesthetic learners
- **It is fun!**



Teed 2004; Jacobson et al.

2006

# Benefits of Games in Issue-based Education

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- Games allow instructors/facilitators to:
  - Teach about complex problems/systems at a level that can be understood
    - Adjust complexity and/or content based on audience
    - Use neutral subject matter for more controversial issues
  - Provide stakeholders with an opportunity to practice problem solving skills in an interactive learning environment
    - Computer models
    - Simulation activities
  - Situate an activity within a narrative, providing players with a context for the problem
    - Provide realistic confines for solutions
    - Provide options for possible solutions/alternative actions

# The Adventures of Carbon Bond

- ▣ Game created for the Southwest Partnership
- ▣ Internet-based game focused on geologic sequestration
- ▣ Game stars action hero Carbon Bond, a special agent for NETL, and his quest to save the planet from climate change by capturing anthropogenic CO<sub>2</sub> and storing it in the vast rock formations of the Southern Rockies



# The Story

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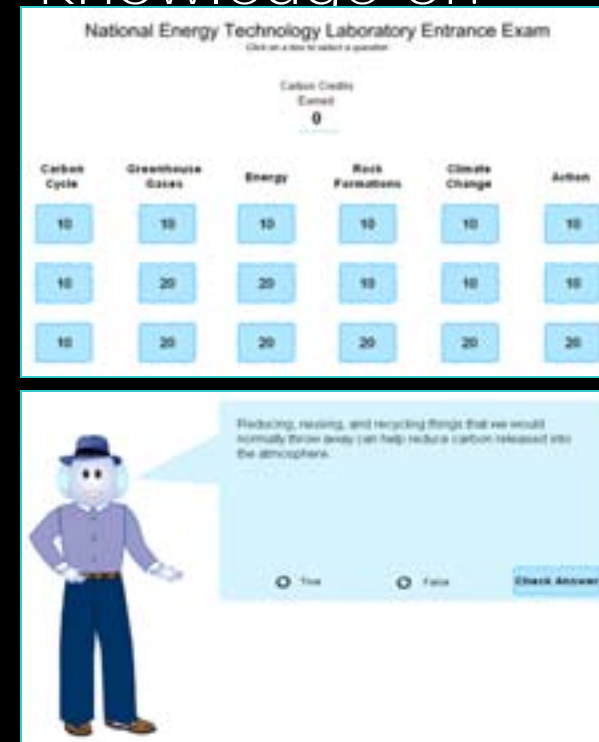
Bond's adventures take him from an Integrated Gasification Combined Cycle (IGCC) power plant to a CO<sub>2</sub> storage facility in the Southern Rockies where the Greenhouse Gas Gang is put away for life.

Youth are encouraged to join Bond on his missions around the world by taking the NETL entrance exam.



# The Game

- Age level: 4<sup>th</sup> to 6<sup>th</sup> grade
- Youth learn and are tested on their knowledge of:
  - The carbon cycle
  - Greenhouse gases
  - Energy production
  - Rock formations
  - Climate change
  - Actions that can be taken at home
- Points are recorded as carbon credits
- Must have a score of 200+ carbon credits to earn a NETL agent badge



# Science Education: Goals of Carbon Bond

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- Teach youth about the technology behind CO<sub>2</sub> capture and storage
- Teach youth about climate change
- Empower youth with ideas to lower
  - their own carbon footprint



# Summary: Pilot Evaluation

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## Benefits

- Gets youth thinking about climate change and possible solutions
- Uses a story to frame the problem and provide context for the game
- Story and game can be played individually or as a class/group

## Drawbacks

- Geologic storage is hard enough to explain to adults let alone youth
- Game is static – little desire to play repeatedly
- Needs to be accompanied by additional curriculum materials/activities

# Questions

<http://www.southwestcarbonpartnership.org/KidsStuff.asp>

x

