

# SCIENCE TEACHER LEADERSHIP TO STRENGTHEN A LEARNING ENVIRONMENT

NATIONAL SCIENCE TEACHERS ASSOCIATION  
Boston, Massachusetts  
April 3, 2014

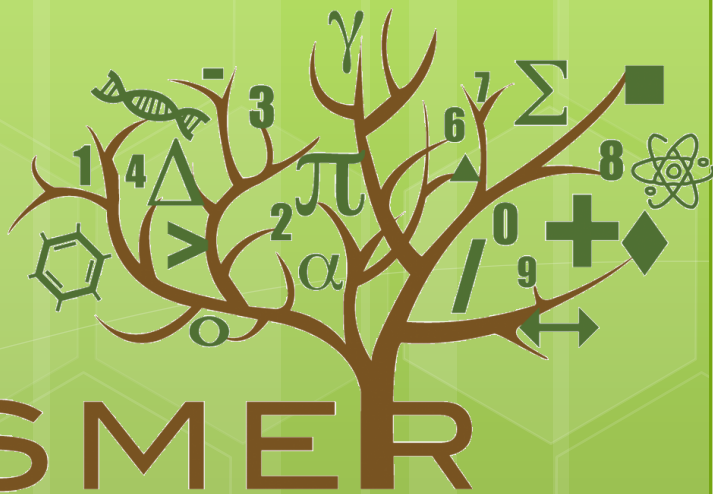


Maximizing Yield Through Integration (MYTI-I3)  
Sponsored by NSF - Award No. 1038166

# Introduction

- Eighteen science and math teachers developed and implemented projects in the context of Environmental Sciences
- In collaboration with University of Puerto Rico, Río Piedras Campus research faculty and graduate students from the IGERT project.
- Connecting the University to schools and communities via field sites for research, learning, and networking.



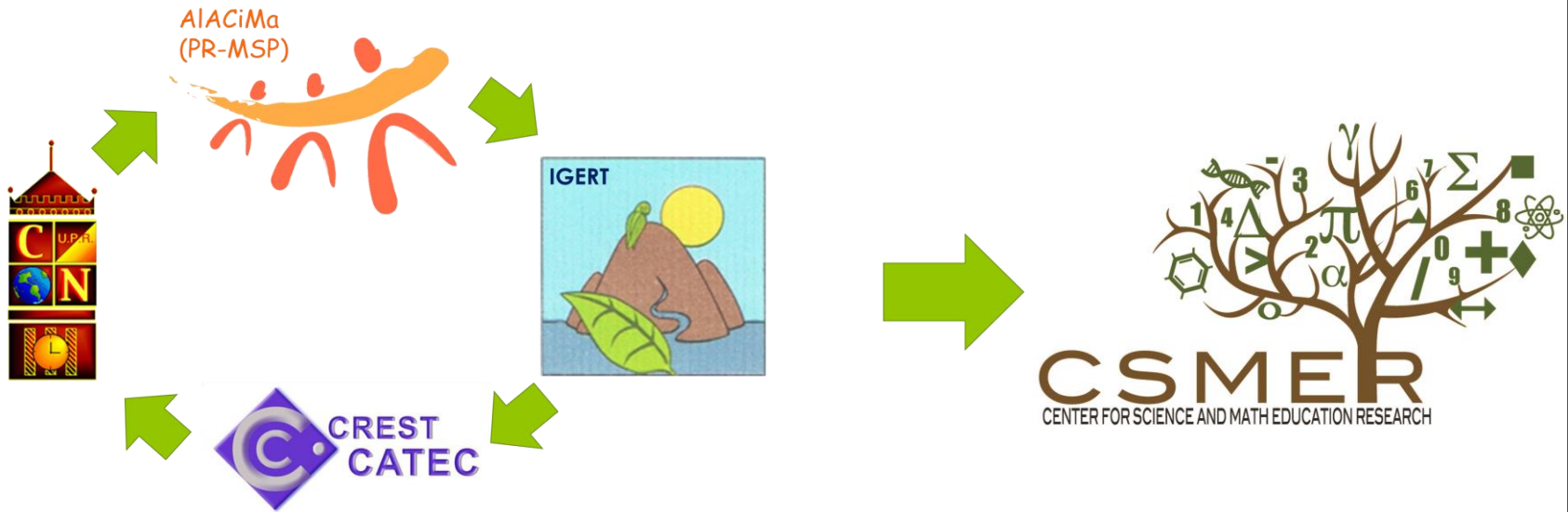


**CSMER**  
CENTER FOR SCIENCE AND MATH EDUCATION RESEARCH

*Science and Math  
Education in  
the Context of a  
Disposing Society*

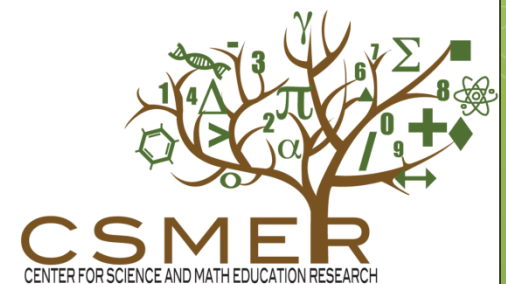
Innovation through  
Institutional Integration (I<sup>3</sup>)

# Maximizing our products...

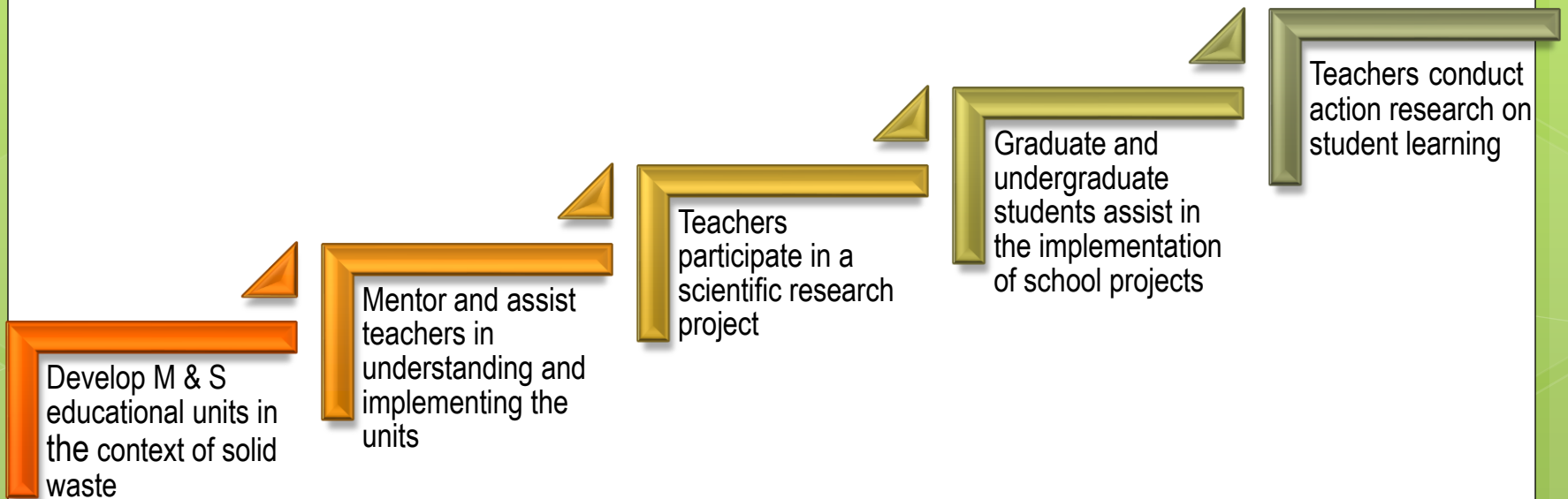


# Vision

- CSMER will provide support to conduct research in science and math education and establish outreach opportunities with partner schools.



# Program Strategy



# Program Activities

## 1<sup>st</sup> Year (2011-12)

- Unit Design for Teachers' Professional Development
  - Integration of IGERT, Education and, Mathematics students
- Professional Development
  - Action Research

## 2<sup>nd</sup> Year(2012 -13)

- Professional Development
  - Solid Waste Management
  - The Science Compost
  - Water Quality
- Scientific research on projects related to environmental sciences

## 3<sup>rd</sup> Year (2013 -14)

- Teachers implement content units.
- Using the learning strategy Project Based Learning (PBL) teachers and students developed school projects related to environmental issues.
  - They receive mentoring and support from the faculty and IGERT & CATEC students.





# Why we used the PBL learning strategy?

The most significant attributes in a PBL curriculum are:

- tackles a real-world problem that is relevant and of some interest to the student,
- has clearly defined goals,
- requires effective team interactions,
- promotes critical thinking,
- allows students choices and decisions at multiple points in the problem solving and design process, and finally,
- requires students to defend their choices



(Powers & Dewartes; 2004; Velázquez y Figarela; 2012).

# School Projects

NAME	TITLE OF PROYECT	SCHOOL	TOWN
Carmen J. Velázquez Rivera	Applying the Problem of Solid Waste to Fast Food Restaurants in Puerto Rico	Sor Isolina Ferré	Ponce
Lymarie Pérez Muler		SU Eugenio María de Hostos	Cayey
Josiel Rosado Tirado	<i>Basura Cero</i>	Juan Quirindongo Morell	Vega Baja
Luis O. De Jesús Torres		Francisco A. Garcia Boyrié	Guayama
Marixa Rodríguez Vega		Especializada Brígida Álvarez Rodríguez	Vega Baja
Minnette Rodríguez Harrison	Environmental Disclosure to analyze the environmental impact (natural landscape) in our community (El Pedregal)	Julián Blanco	Guaynabo
Carmen M. Ruiz Méndez	Hydrological Study in Quebrada Juan Méndez at Río Piedras	Central Especializada Artes Visuales	San Juan
Jadira Aponte Ramírez	Potential Development of Agriculture in Urban Areas in the Municipality of Orocovis	Alberto Meléndez	Orocovis
Tomás Díaz Berrios		José Rojas Cortés	Orocovis
Oswaldo Parés Rivera	Reduction of Solid Waste	Eugenio María de Hostos	Mayaguez
Sylvia Hernández Acevedo		Dr. Carlos González	Aguadilla
Loudes R. Rivera González	The Development of Alternatives to Reduce the Amount of Solid Waste Generated by Students from 4 Public Schools in 4 Geographic Areas of Puerto Rico	Juan D. Stubbe	Caguas
María L. Ortiz Hernández		Generoso E. Morales	San Lorenzo
Myrna Hernández Nieves		Catalina Morales de Flores	Moca
Sandra Beltrán Morales		Francisco Gaztambide Vega	Bayamón
Amabel T. Soto Guzmán	Impact of Solid Waste to our Community in Terms of Volume and the Surface Area it Occupies	Carmen L. Feliciano Carreras	Río Grande
Marilyn Santiago Román		Nueva Intermedia Piletas	Lares
Yamily Colón Negrón		Jose Santos Alegria	Dorado

# Our Fellows



Study of the physical and chemical changes of matter through different alternatives of solid waste management

Myrna Hernández  
Catalina Morales High School  
San Sebastian School District



Maximizing Yield Through Integration (MYTI-I3) – Sponsored by NSF  
Award No. 1038166

# RESEARCH QUESTION

Is the school project Educate, Act, and Live effective to improve the students' understanding of the physical and chemical changes of matter?



# INTRODUCTION

Some topics discussed in the chemistry course are characterized by abstractions, affecting the understanding of chemistry concepts.

Working with real world problems like solid waste management, will help students find answers to problems in their community and also improve their understanding of the physical and chemical changes of matter.



# JUSTIFICATION

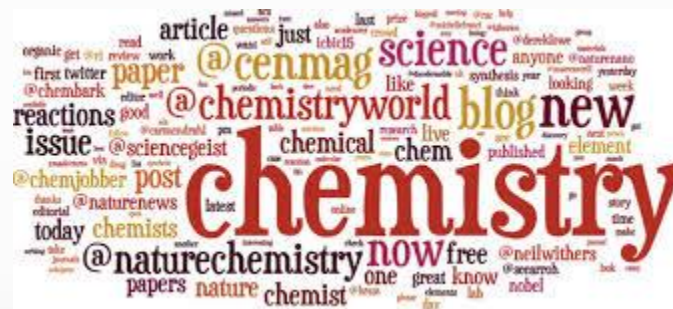


- Secondary level students have alternative conceptions on the structure of matter. If they understand the microscopic nature of matter they can comprehend how it changes physically or chemically.
- It is necessary to identify educational strategies that promote a better understanding of the nature of matter and its changes.

# ALTERNATIVE CONCEPTIONS

The alternative conceptions studied are related with one of the following concepts:

- change in color
- change of state
- dissolve
- mix
- burn and heat
- change in temperature
- evidence of physical and chemical changes
- change in mass
- organization of particles





# ACTIVITIES: PBL ON SOLID WASTE

- Motivational Video on Solid Waste
- Educational lectures on structure of matter and physical and chemical changes
- Internet search about different alternatives to manage solid waste and the changes of matter
- Field trips to a landfill, compost plant, and recycling company
- Create a school garden with used tires, compost, and newspaper
- Laboratory activities
- Power Point presentation



# SAMPLE

- ✓ 26 eleventh grade students from the Catalina Morales High School from Moca, P.R.
- ✓ Selected students are 15-16 years old
- ✓ Grade point average between 3.50 and 4.0.



# DATA COLLECTION

- Pre/Post test on physical and chemical changes of matter
  - 6 multiple choice exercises
  - 11 exercises to classify physical and chemical changes
  - 1 open response exercise



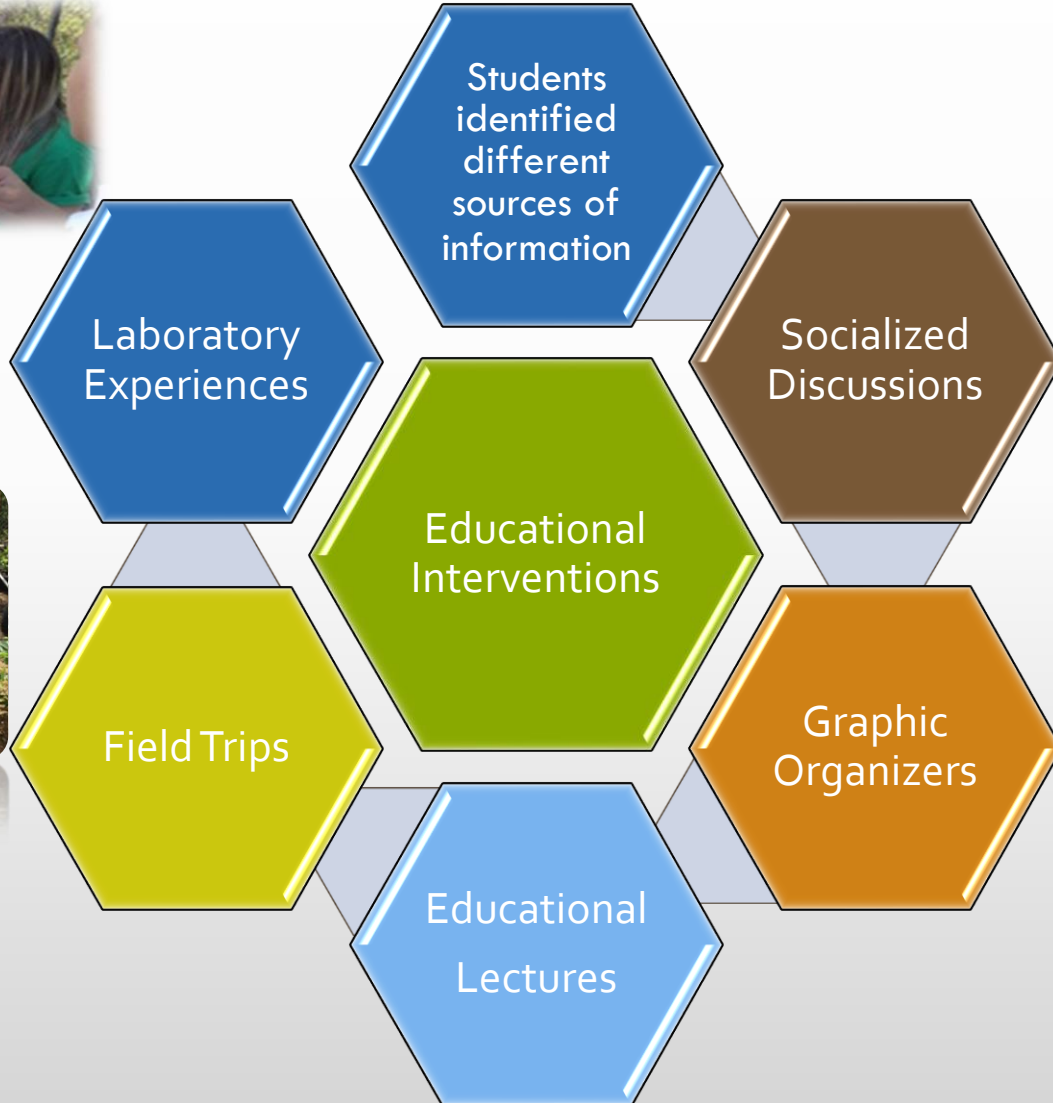
# DATA COLLECTION

## Test Design:



- ❑ Alternative conceptions, about the law of conservation of matter and the physical and chemical changes were identified in the literature.
- ❑ All items were aligned to the Content Standards and Grade Expectations of the Science Program, of PR Department of Education.

# EDUCATIONAL INTERVENTIONS

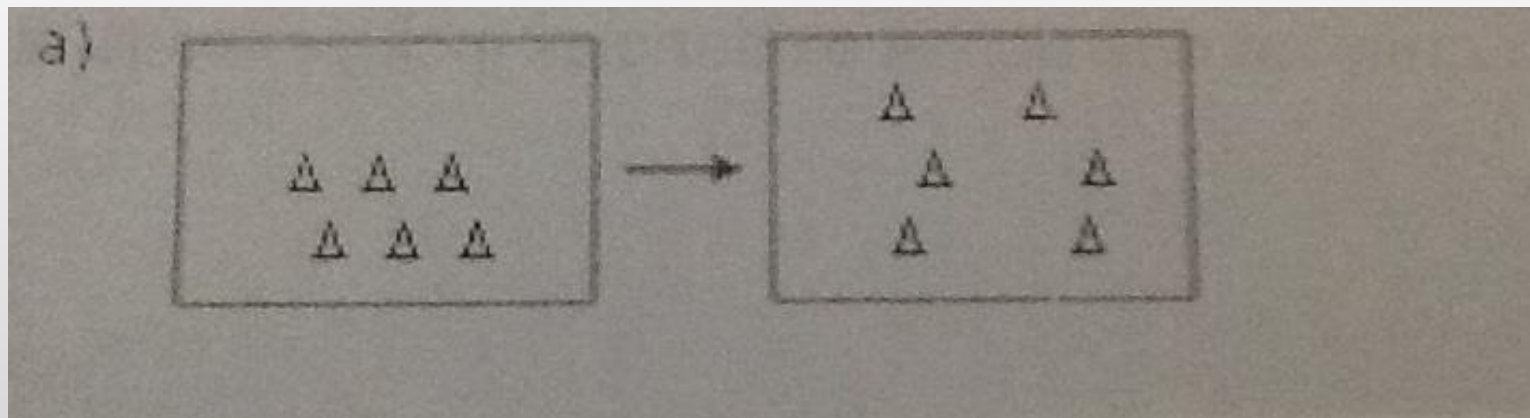


## Question 6

In this question the students have to explain what happens in a chemical reaction at the microscopic level.

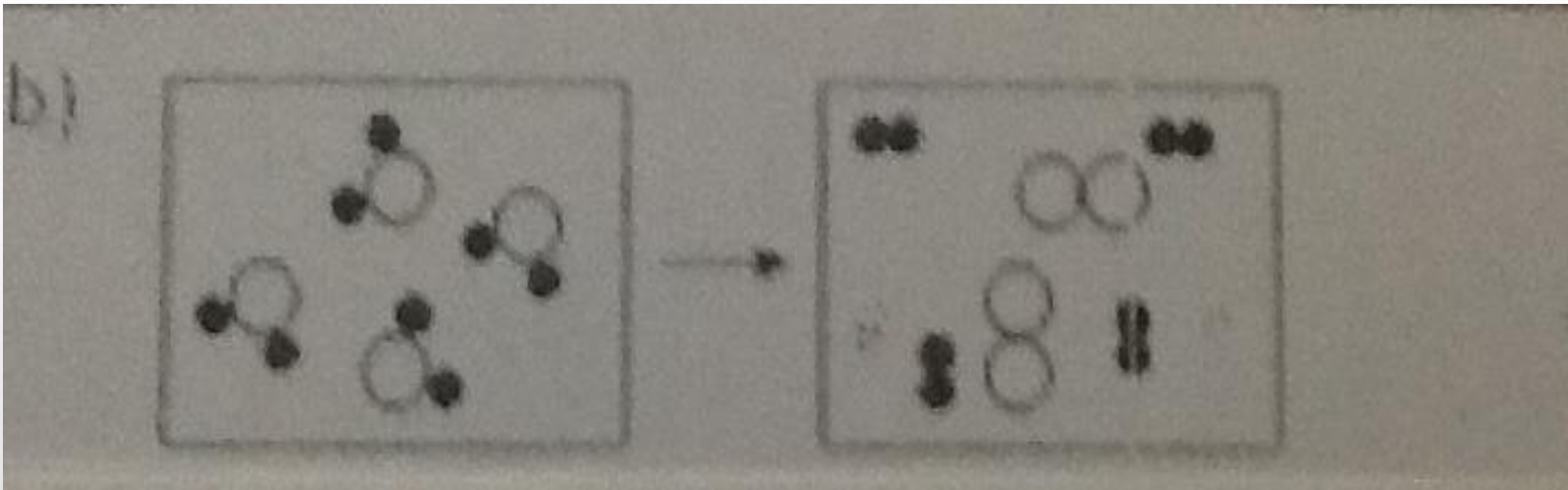
### Alternative a

Alternative conception: A change of state is a chemical change



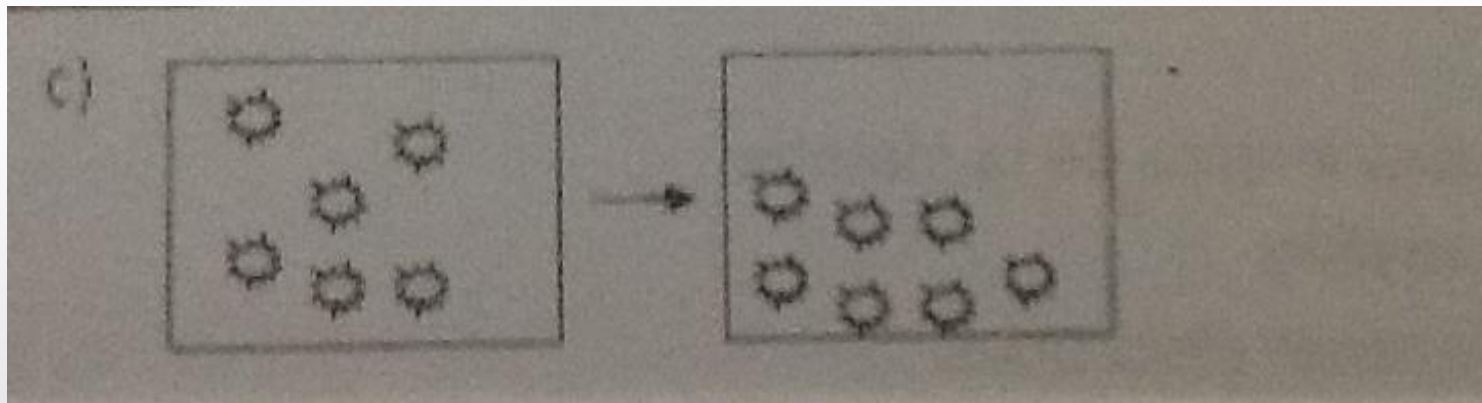
# Alternative b

**Correct answer:** the particles reorganize forming different substances



# Alternative c

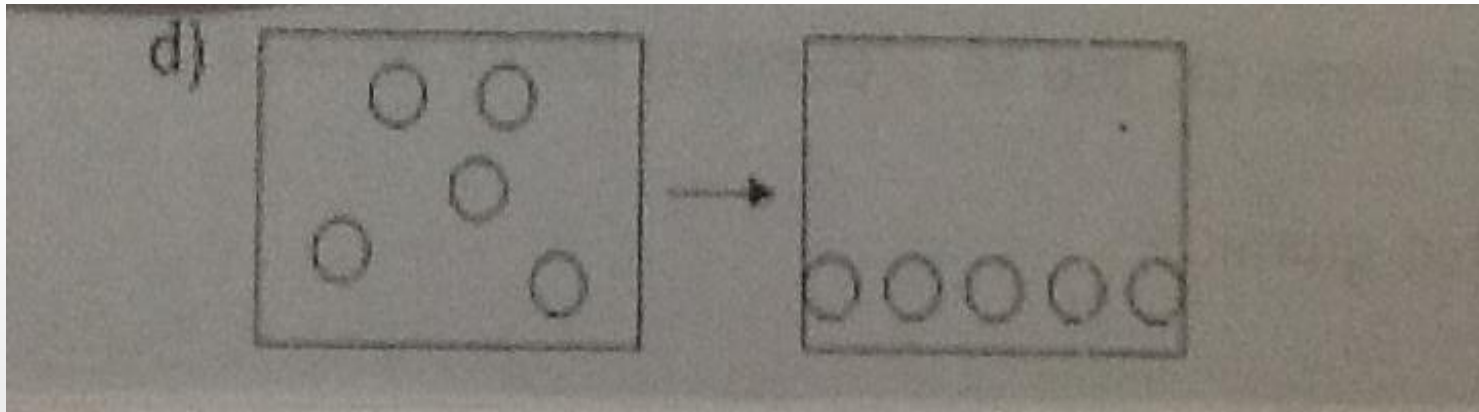
Alternative conception: chemical change because an extra particle is formed





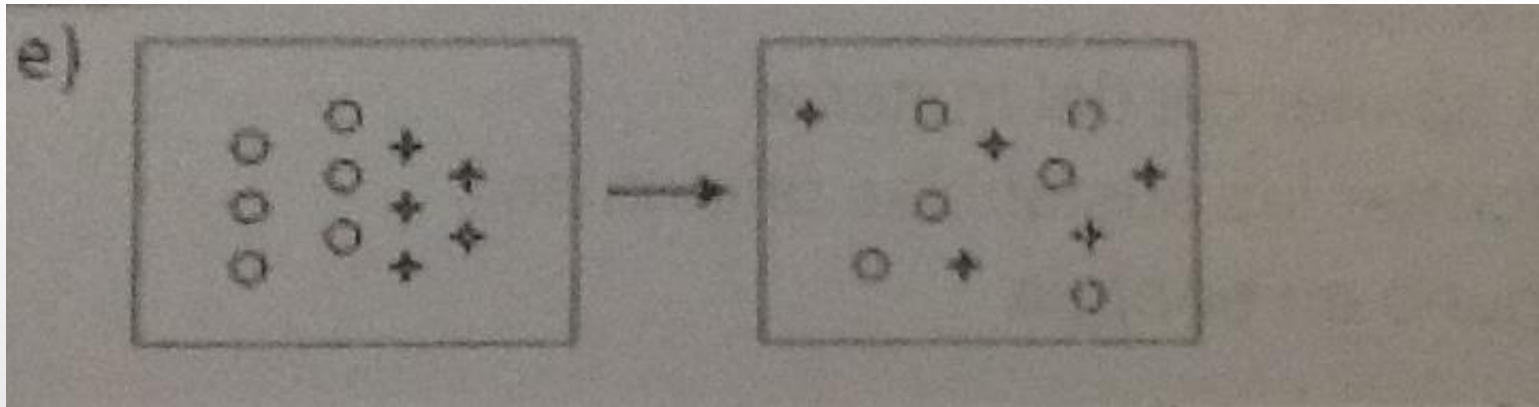
## Alternative d

Alternative conception: A change of state is a chemical change



# Alternative e

Alternate conception: Mixing is a chemical change



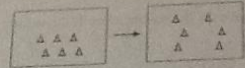
# Test answers

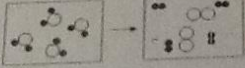
## Pre test

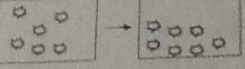
~~b~~ 5. ¿Cómo se diferencia un cambio físico de uno químico?

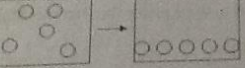
- Se observan nuevas propiedades de la materia
- Nuevas sustancias son producidas
- Los cambios siempre incluyen luz o calor
- La identidad de la materia no cambia

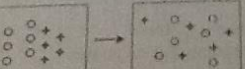
~~e~~ 6. ¿Cuál de los siguientes diagramas representa un cambio químico?

a) 

b) 

c) 

d) 

e) 

Escogí esta contestación por que las moléculas pararon de estar separadas a mezclarse.

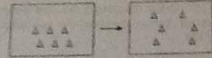
I selected this answer because the molecules were separated and then mix.

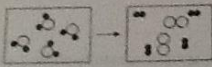
## Post test

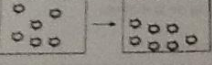
~~d~~ 5. ¿Cómo se diferencia un cambio físico de uno químico? En uno físico.

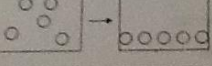
- se observan nuevas propiedades de la materia
- nuevas sustancias son producidas
- los cambios siempre incluyen luz o calor
- la identidad de la materia no cambia

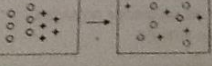
~~b~~ 6. ¿Cuál de los siguientes diagramas representa un cambio químico? Justifica

a) 

b) 

c) 

d) 

e) 

Es un cambio químico porque las partículas crearon otro compuesto diferente.

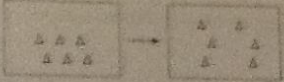
Is a chemical change because the particles created a new compound.

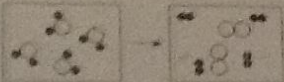
# Test answers

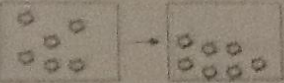
## Pre test

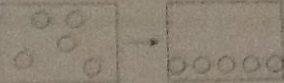
cambios siempre incluyen luz o calor  
identidad de la materia no cambia

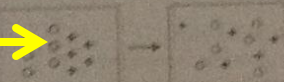
de los siguientes diagramas representa un cambio químico?

a) 

b) 

c) 

d) 

e) 

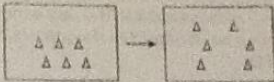
porque estaban cerca pero no  
y luego en la siguiente imagen  
mezclados

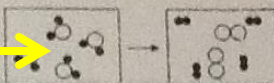
Because particles are close to each other, but not mixed and then they appear mixed.

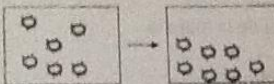
## Post test

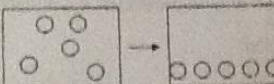
b. nuevas sustancias son producidas  
c. los cambios siempre incluyen luz o calor  
d. la identidad de la materia no cambia

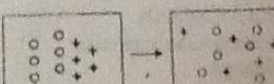
6. ¿Cuál de los siguientes diagramas representa un cambio químico? Justifica

a) 

b) 

c) 

d) 

e) 

por que estaban todos unidos y  
luego se separaron por completo  
y se unieron con sus nuevos átomos  
formando un nuevo compuesto.

Because the particles were close together and then they separated and interact to form new compounds.

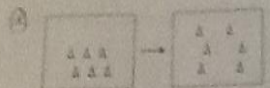
# Test Answers

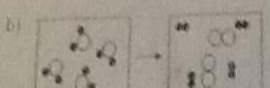
Pre test

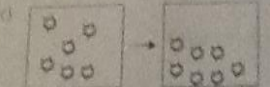
4. ¿Cómo se diferencia un cambio físico de un cambio químico?

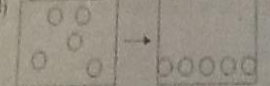
- a) Se observan nuevas propiedades de la materia
- b) Nuevas sustancias son producidas
- c) Los cambios siempre incluyen luz o calor
- d) La identidad de la materia no cambia

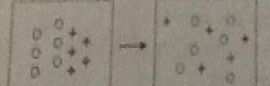
5. ¿Cuál de los siguientes diagramas representa un cambio químico?

(a)  *Por que los particulas estan de una forma la cual causa un cambio quimico*

(b) 

(c) 

(d) 

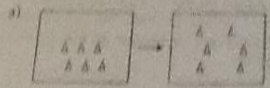
(e) 

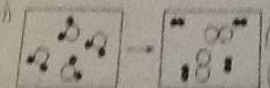
Because the particles are in a way that cause a chemical change

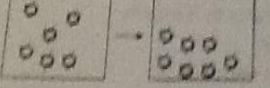
Post test

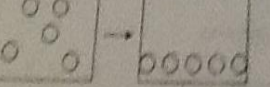
a. se observan nuevas propiedades de la materia  
b. nuevas sustancias son producidas  
c. los cambios siempre incluyen luz o calor  
d. la identidad de la materia no cambia

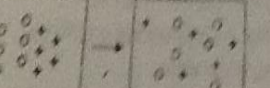
6. ¿Cuál de los siguientes diagramas representa un cambio químico? Justifica

(a) 

(b)  *Esta es una reaccion quimica por que las moleculas se separan y se unen a una nueva sustancia.*

(c) 

(d) 

(e) 

This is a chemical reaction because the molecules separated and then combine transforming the matter.



## Open response exercise

**18. Each one of the following question describes the combination of two or more substances. Explain if each one of the descriptions correspond to a chemical change. Justify your answers.**

- a. Substance A is added to substance B. The freezing point of substance B lowers  $5^{\circ}\text{C}$ .
- b. Substances X and Y are mix together. A magnet is used to remove substance Y.
- c. Particles of substance A are suspended in a river.
- d. When substance S is added to substance R it dissolved.
- e. When the solid substance L is added to the liquid P an explosion occurs. The product formed has a lower mass.

# Pre test question

## Pre test

14. Clasifica los siguientes cambios en químicos o físicos. Utiliza la Q para químicos y la F para físicos.

- F 7. derretir aluminio
- Q 8. calentar aceite
- Q 9. oxidación de un metal
- F 10. hervir agua
- F 11. tirar un huevo
- Q 12. formación de compuestos
- Q 13. quemar basura
- Q 14. derretir plástico
- Q 15. reacción de metal con ácido
- Q 16. Formación de biodiesel
- F 17. inflar neumáticos

15. Cada una de las siguientes oraciones describe la combinación de dos o más sustancias. Explica si cada una de las descripciones corresponde a un cambio químico. Justifica tus respuestas.

- a. La sustancia A se añade a la sustancia B. El punto de congelación de la sustancia B disminuye 5°C. *Químico, cambia el p. de congelación*
- b. Se mezclan las sustancias X y Y. Un imán es utilizado para remover partículas de la sustancia Y. *Químico, no se ha producido un cambio físico de la materia*
- c. Las partículas de la sustancia A están suspendidas en la sustancia Z. *Químico, las partículas de Y se han unido a las de Z*
- d. Cuando la sustancia S se añade a la sustancia R, esta se disuelve. *Químico, forma la S en combinación con la R*
- e. Cuando las sustancias sólidas L se añaden al líquido P ocurre una explosión. La sustancia resultante posee una masa menor que la masa combinada de L y P. *Químico, se produce un cambio en presencia de otro estado*

Chemical, because there was a change in the presence of another matter.

## Post test

14. Clasifica los siguientes cambios en químicos o físicos. Utiliza la Q para químicos y la F para físicos.

- F 7. derretir aluminio
- F 8. calentar aceite
- Q 9. oxidación de un metal
- F 10. hervir agua
- F 11. tirar un huevo
- Q 12. formación de compuestos
- Q 13. quemar basura
- Q 14. derretir plástico
- Q 15. reacción de metal con ácido
- Q 16. Formación de biodiesel
- F 17. inflar neumáticos

15. Cada una de las siguientes oraciones describe la combinación de dos o más sustancias. Explica si cada una de las descripciones correspondió a un cambio químico. Justifica tus respuestas.

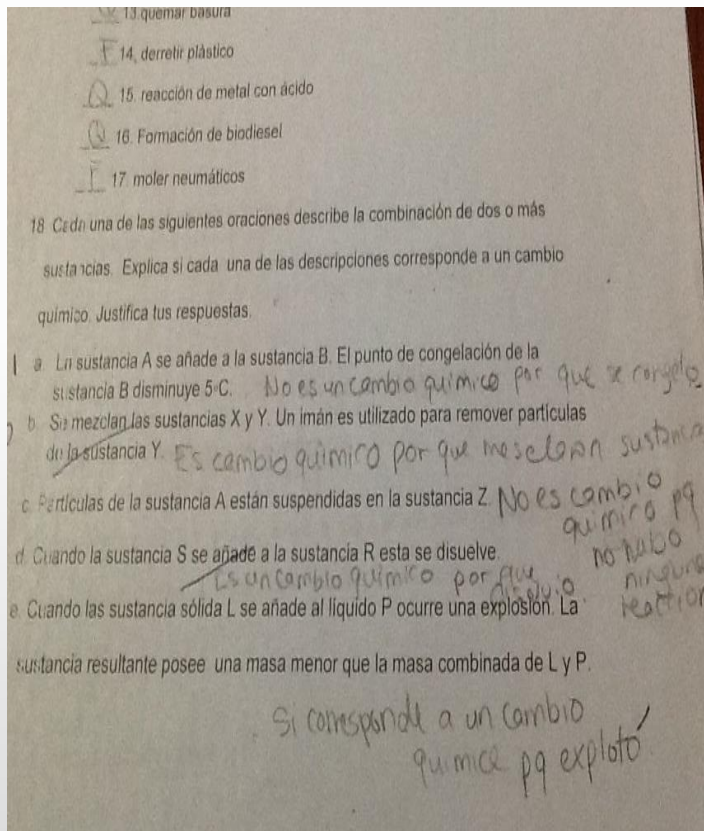
- a. La sustancia A se añade a la sustancia B. El punto de congelación de la sustancia B disminuye 5°C.
- b. Se mezclan las sustancias X y Y. Un imán es utilizado para remover partículas de la sustancia Y.
- c. Partículas de la sustancia A están suspendidas en un no.
- d. Cuando la sustancia S se añade a la sustancia R, esta se disuelve.
- e. Cuando las sustancias sólidas L se añaden al líquido P ocurre una explosión. La sustancia resultante posee una masa menor que la masa combinada de L y P.

*Químico por haber una explosión y la masa disminuye por la liberación de la materia como gases de liberación por eso hubo menor masa de la materia que se combinó y se liberó solo se transfirió*

Chemical because there was an explosion and the mass decrease because gases are produced.

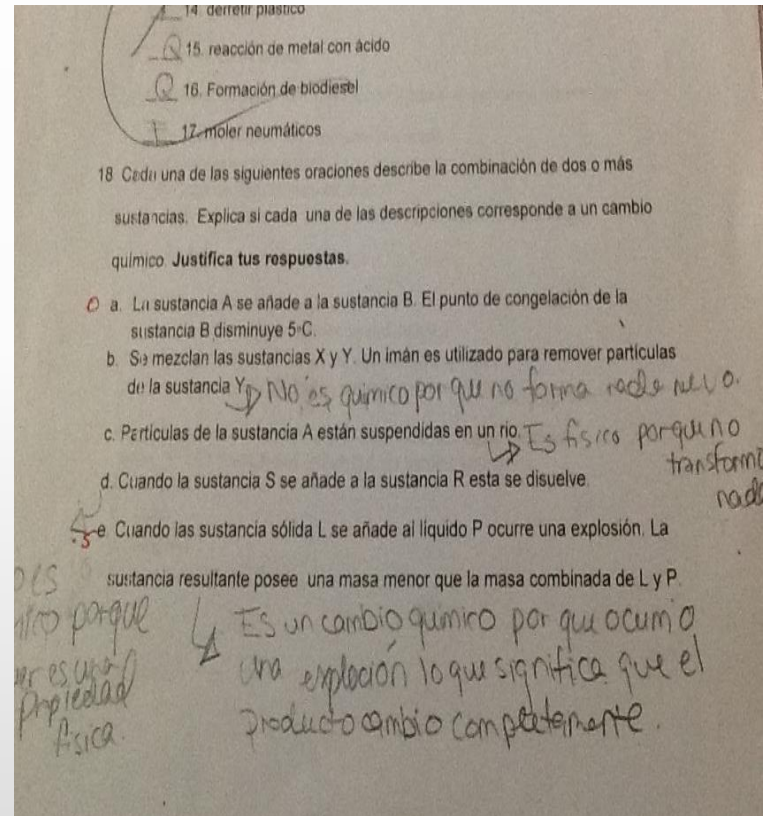
# Test answers

## Pre test



Chemical change because an explosion was produced

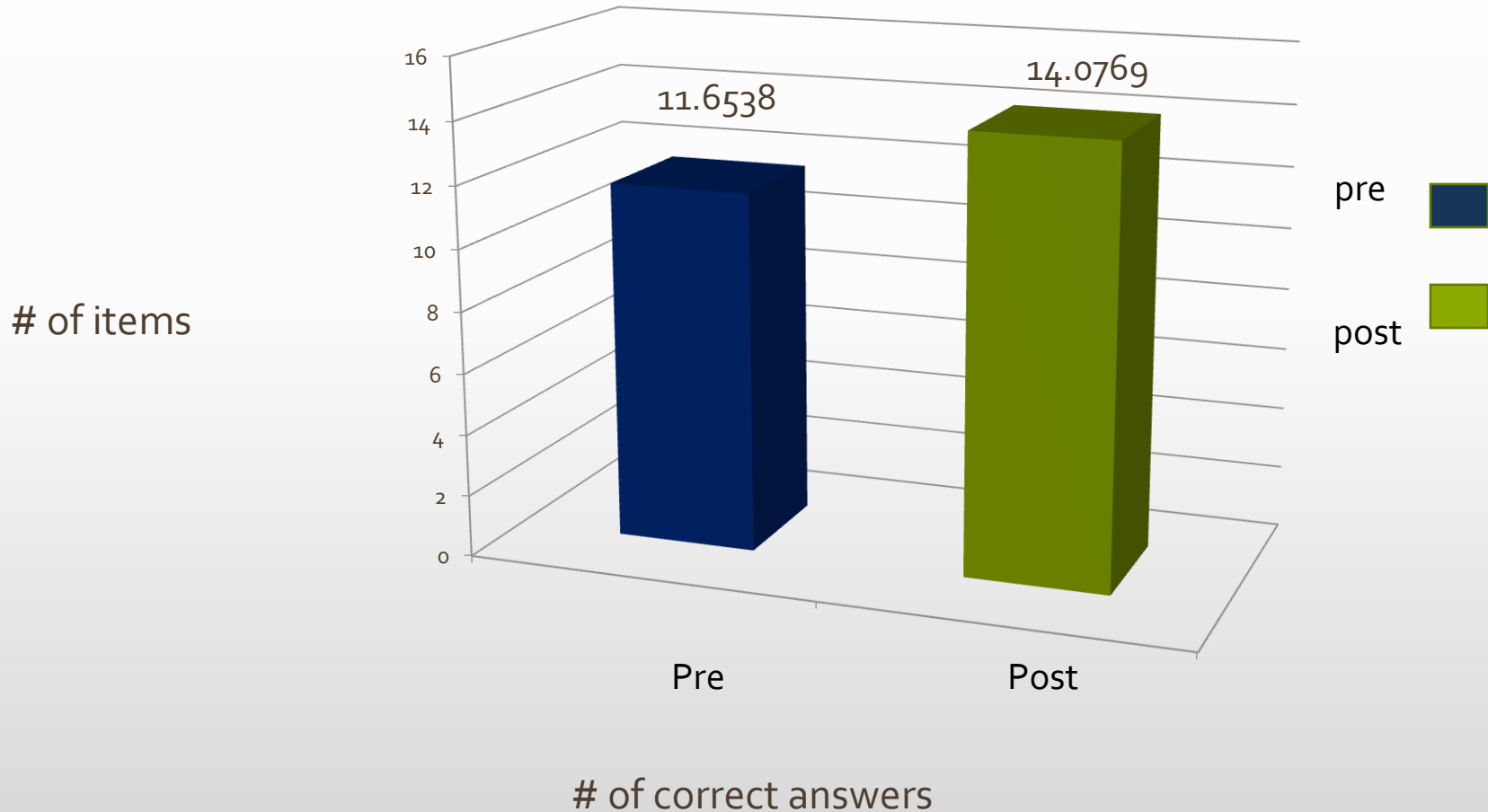
## Post test



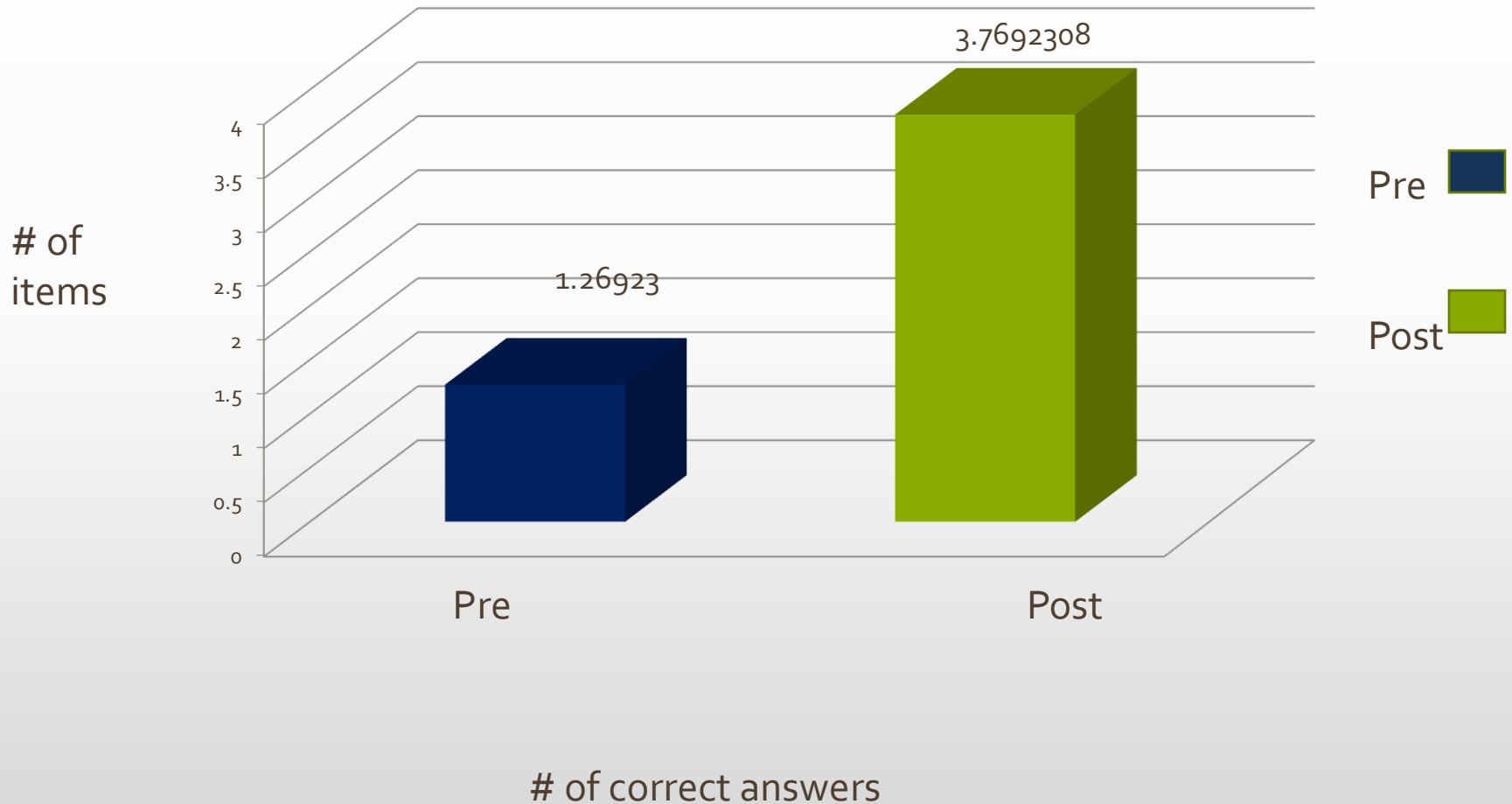
Is a chemical change because an explosion was produced and the product change completely.



# Pre test vs. Post Test



# Pre test vs. Post test Open response exercise



# RESULTS AND DISCUSSION

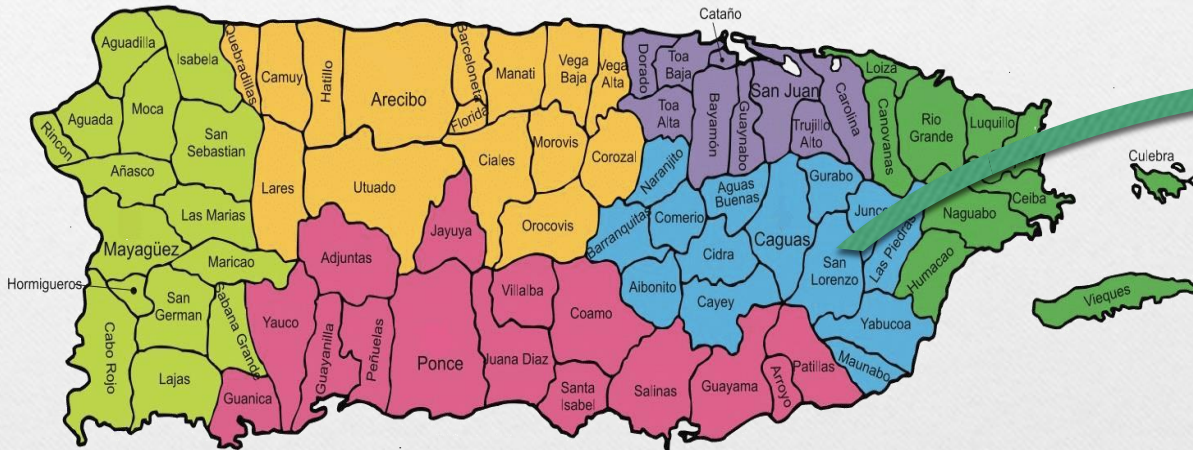
- The results indicate that most of the students increased their scores in the multiple choice questions in the post test.
  - All the scores were between 70% to 100%.
- 
- The answers to the open-ended questions in the post test demonstrated that students modified their alternative conceptions related with the concepts of physical and chemical change of matter.

# CONCLUSION

- Using the PBL strategy in the context of solid waste could help students improve their understanding on changes of matter.
- The PBL strategy demonstrated to be a motivational tool to improve the students' understanding of core chemistry concepts.
- There were some alternative conceptions that require more time to be modified.

# Using the School Project “Educate, Act, and Live” to improve students’ understanding of the carbon and nitrogen cycles.

María L. Ortiz Hernández  
Generoso E. Morales School  
School District: San Lorenzo



Maximizing Yield Through Integration (MYTI-13)  
Sponsored by NSF - Award No. 1038166



# RESEARCH QUESTION

Does the School Project “Educate, Act, and Live” improve students’ understanding of the carbon and nitrogen cycles?



# INTRODUCTION

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For years, the levels of academic achievement in science concepts, of my middle school students, has been declining.

These results can be evidenced in their Academic Achievement Tests and Alternate Assessment scores offered by the Puerto Rico Department of Education.

(Results of PPAA -2010-2011 and 2011-2012)

## INTRODUCTION (cont.)

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Consequently, my efforts were directed to identify educational strategies that promote the involvement of my students in their learning process.

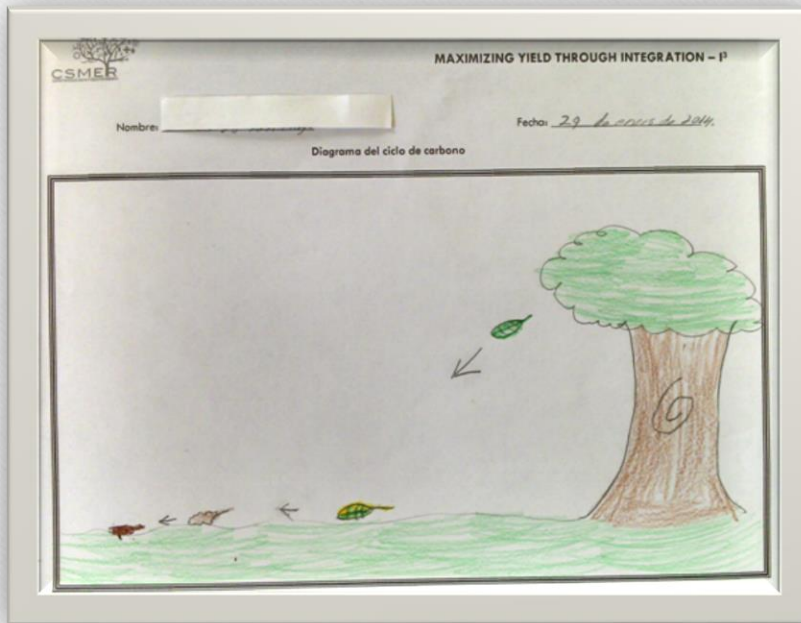
The lessons learned through these experiences could improve their academic achievement and at the same time be applied to their daily lives.





# INTRODUCTION (cont.)

I tried to correct some misconceptions that students had about the Carbon and Nitrogen Cycles. An accurate understanding of biogeochemical cycles can transform deeply held beliefs. Successfully teaching this topic can have the collateral benefit of inspiring lasting interest in science (O'Connell, 2010).



“Matter dies and nothing else happens”

Students are not able to identify or understand the process in which matter is transformed.

# SAMPLE

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Two groups of seventh grade students were selected.

- ❑ The **control group** consisted of 23 students from the mainstream

- ❑ The **experimental group** consisted of 23 students:
  - ❑ 20 students from the mainstream and
  - ❑ 3 students with special needs (two with specific learning disabilities and one with autism)
    - ❑ integrated into the mainstream



# EDUCATIONAL INTERVENTIONS

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- ❑ PBL strategy to work the school project: **Educate, Act, and Live!**
- ❑ School Project Problem: The generation, handling, and improper disposal of solid waste
- ❑ Curricular theme: the Carbon and Nitrogen Cycles

# EDUCATIONAL INTERVENTIONS

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- ❑ Pre-test about the Carbon and Nitrogen Cycles
- ❑ Motivating activities: videos and homework
- ❑ Collaborative work : The class was divided into five groups and each group sought information on one of the alternatives presented: reduce, reuse, recycling, energy recovery, and landfill.
- ❑ Power Point presentation
- ❑ Oral report
- ❑ Oral discussion



## EDUCATIONAL INTERVENTIONS (Cont.)

- ❑ Composting (natural recycling) and vertical farm of crops (emphasis on reuse). The preparation of compost and vertical farm were used to explain the Carbon and Nitrogen Cycles.
- ❑ The teacher clarified questions that the students made after the process of:
  - ❑ reading
  - ❑ using videos
  - ❑ power point presentations
  - ❑ oral discussion
- ❑ Post-test



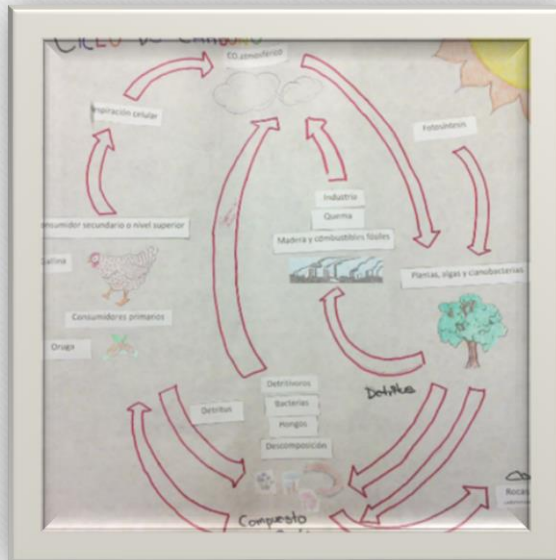
# DATA COLLECTION

- Pre/Post test

  - Eleven multiple-choice items

- Drawing of the Carbon and Nitrogen Cycles.

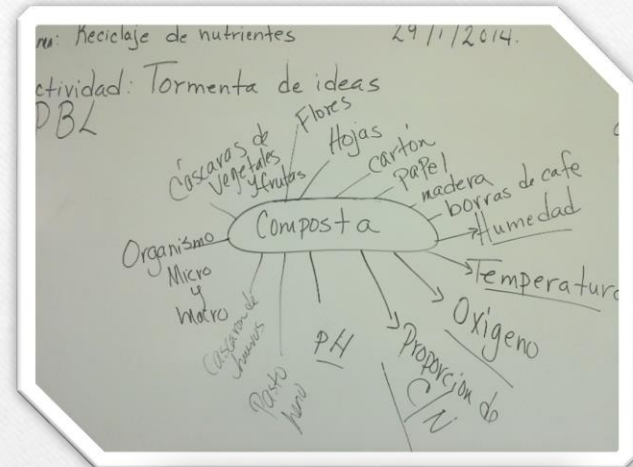
  - The diagrams were evaluated using rubrics.



# DATA COLLECTION

## ✓ Brainstorming technique:

To determine if the student needed to clarify misconceptions of the concepts of composting, carbon, and nitrogen cycles.



## ✓ Individual reflection:

To collect qualitative data on students perception regarding their learning process on curricular issues discussed during the project.

Reflexiona sobre lo que has aprendido sobre los temas trabajados durante el proyecto escolar:

Trabajo en equipo:  
El trabajo en equipos muy efectivo y muy divertido. Para mejorar nuestra aprendizaje.

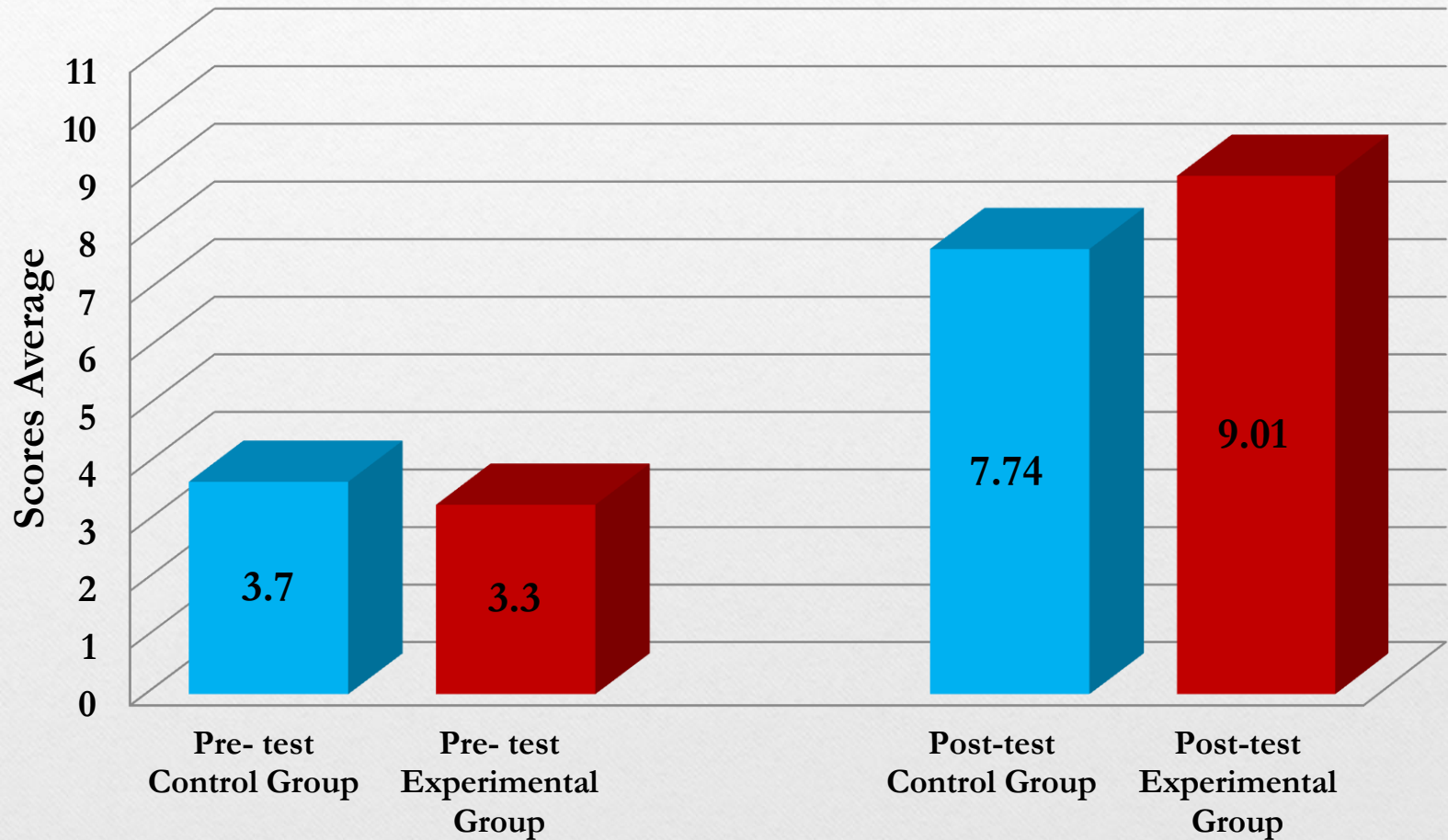
Desperdicios sólidos:  
Hay muy mal uso de los desperdicios sólidos. Proponemos campañas de reciclaje y en problema hay que reciclarlos.

Ciclo de carbono y ciclo de nitrógeno:  
No se maneja la natural de reciclaje. Proponemos que la materia no se desperdicia. Que los desperdicios son muy importantes.

Composta y cultivos verticales:  
son una vía para mejorar. Vimos que no es necesaria. Water todo y que los bioactivos son importantes.

# Results

Pre and Post-test Results of the Control Group Vs Experimental Group





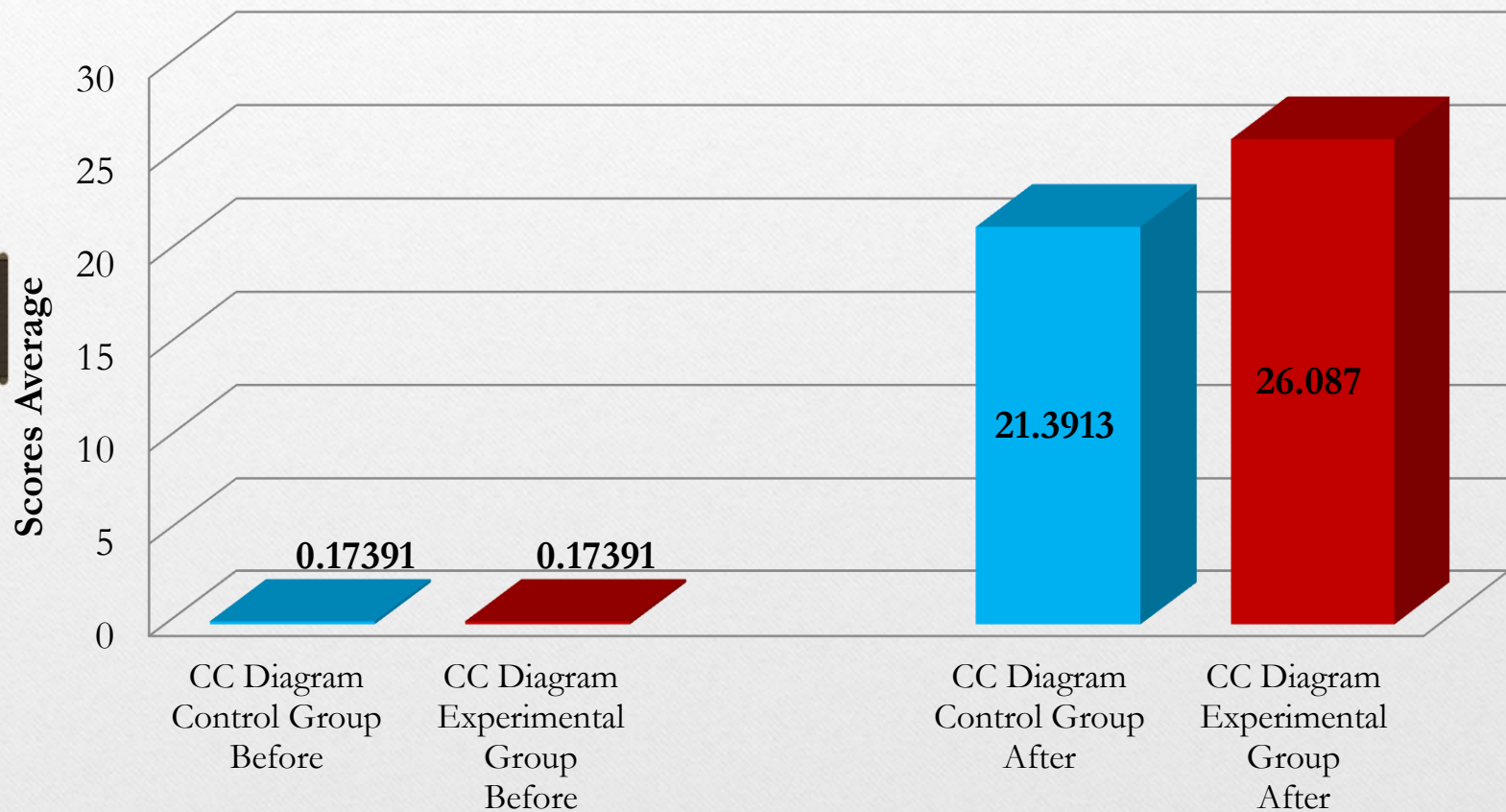
# Statistical Analysis T-test

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- To establish the differences between the means of the control group and the experimental group.
- The test yielded a value of 3.62 ( $p = 0.001$ ).
- This value means that there was a greater increase in the academic achievement of the experimental group over the control group.

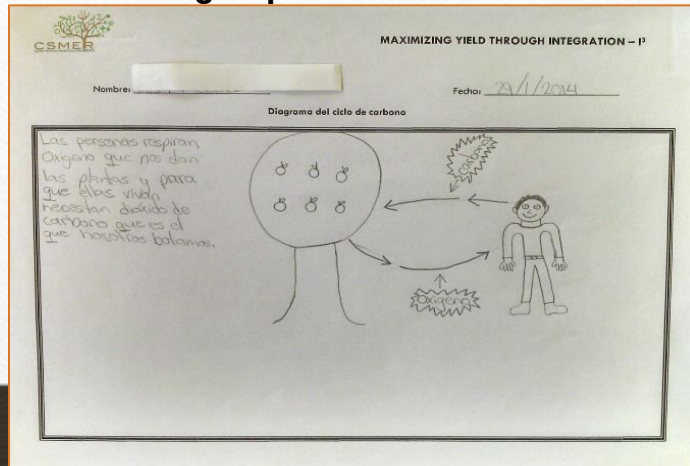
# Results

## Carbon Cycle Diagrams of the Control Group vs Experimental Group



# Carbon Cycle Diagrams

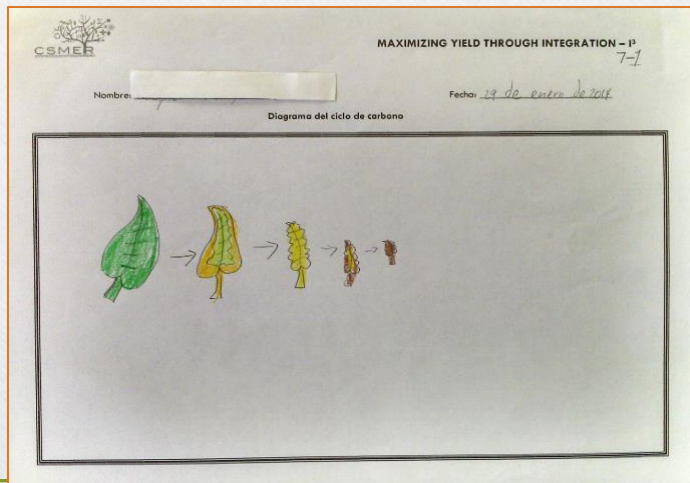
## Control group before the discussion



The student demonstrated a lack of knowledge on the subject by indicating that plants:

- Give us oxygen and we exhale CO<sub>2</sub>.
- Acquire carbon from the soil rather than from the air during photosynthesis.

## Experimental Group before beginning the school Project



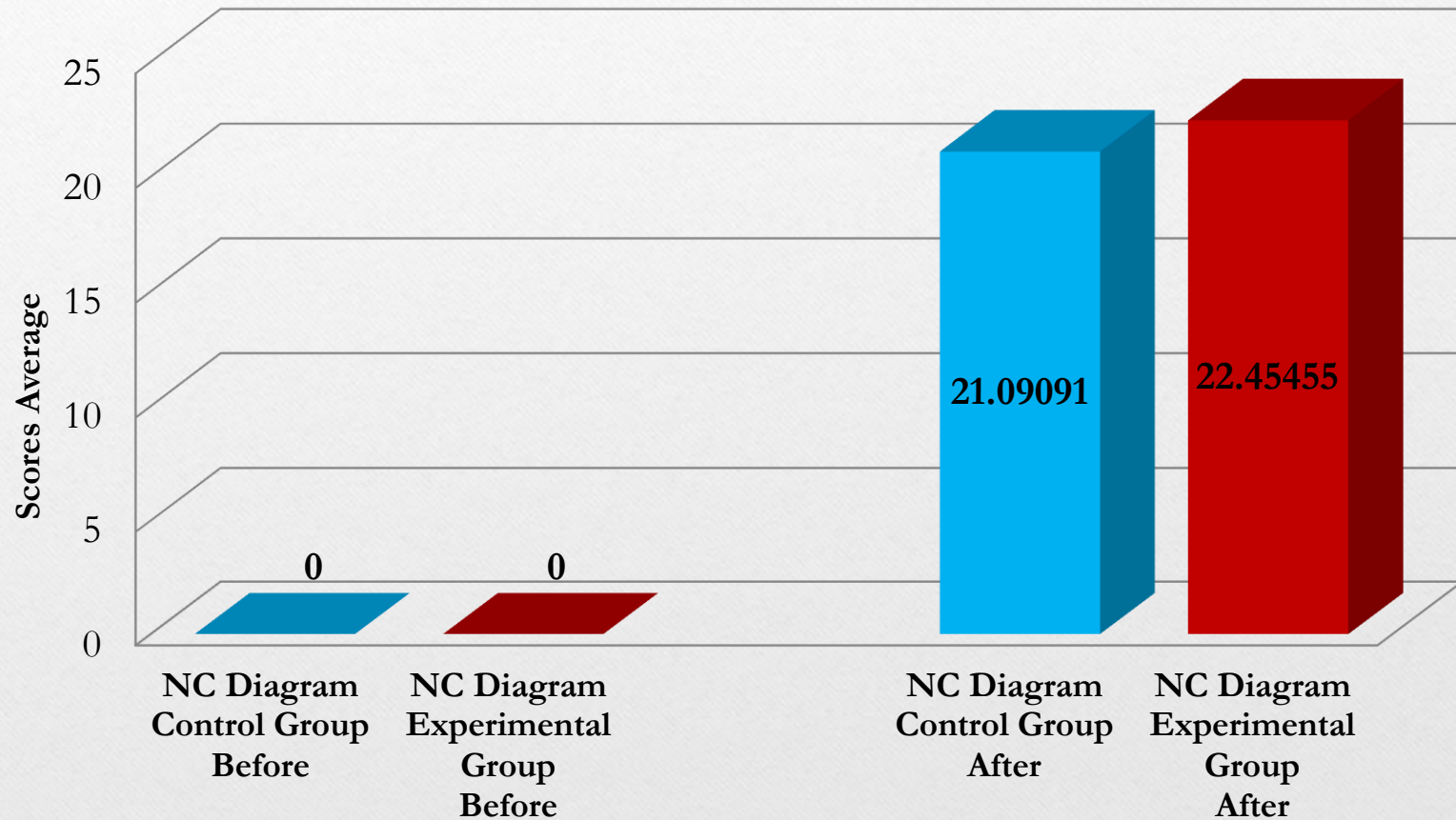
The student demonstrated a lack of knowledge on the subject by:

- Representing alternative conceptions about the subject
- Indicating that organic matter dies and nothing else happens
- Demonstrating that they didn't understand the process in which matter is transformed.



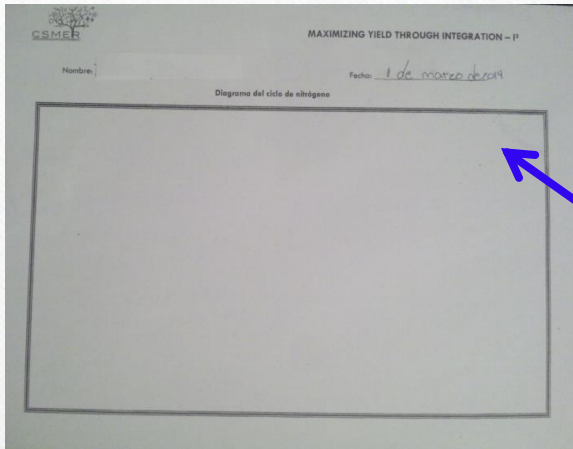
# Results

## Nitrogen Cycle Diagrams of the Control Group vs Experimental Group

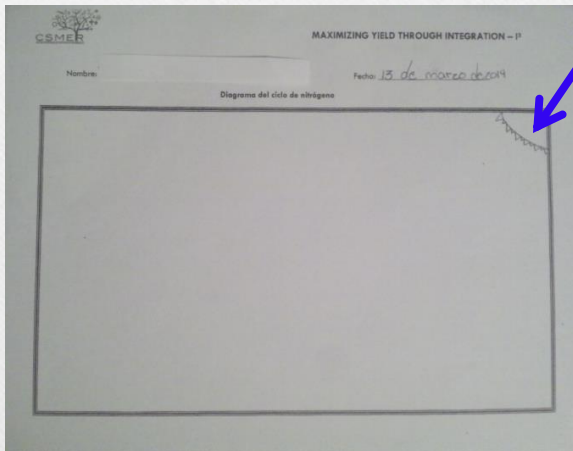


# Nitrogen Cycle Diagram

## Control Group before the discussion



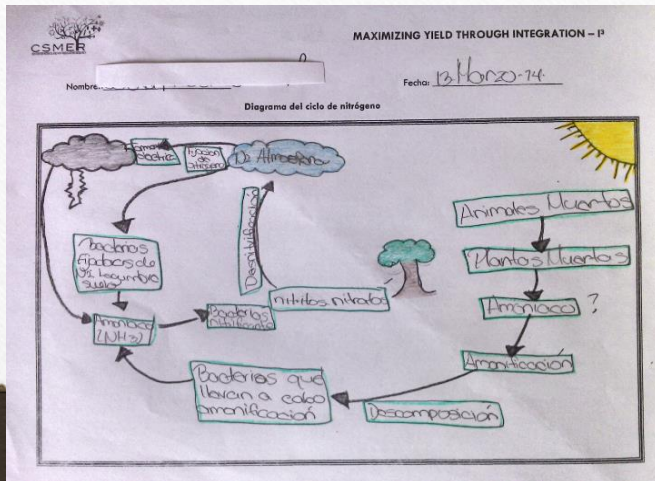
## Experimental Group before beginning the school Project



Both groups demonstrated a lack of knowledge on the subject.

# Nitrogen Cycle Diagram

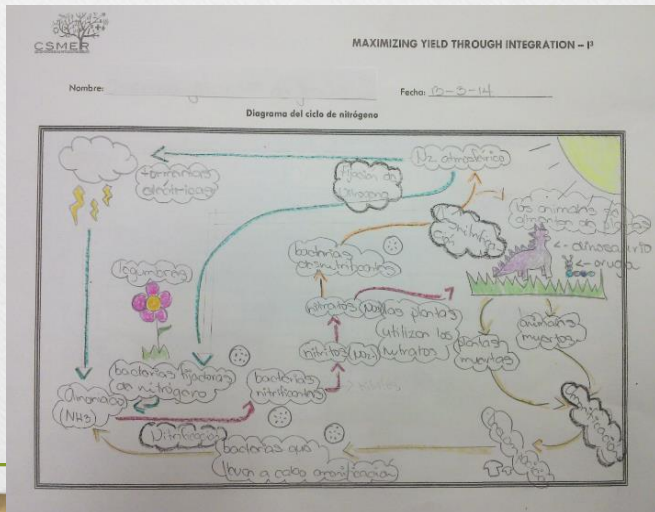
## Control Group After the discussion



The students:

- Presented an incomplete diagram of the process.
- Represented the role played by bacteria in the different process of the cycle, except in the denitrification process.

## Experimental Group At the end of the School Project



The student:

- Identified all transformations in nitrogen cycle.
- Represented that dead matter is transformed and the role of microorganisms in the process.
- This diagram did not present any misconceptions about matter decomposition by soil organisms.

# RESULTS AND DISCUSSION

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- Tracing matter is one of the fundamental principles in Biology and can be used as a tool for reasoning about biological processes (Asshoff, R., Riedl, S. & Leuzinger, S. 2010).
- Also can help students understand the complexity and variety of natural processes.





# RESULTS AND DISCUSSION

---

- ❑ Students have difficulty understanding the importance of microscopic organisms in the Carbon Cycle.
- ❑ It is challenging for students to comprehend how plants, through photosynthesis, turn an invisible gas into organic molecules in biomass that they can see, touch, and taste.
- ❑ It is equally challenging for them to comprehend how invisible microbes that live in environments such as soil can decompose those organic substrates back into invisible carbon dioxide, thus completing the Carbon Cycle.

# CONCLUSION

---

- The final results showed that both groups improved their understanding on the science concepts, but the experimental group had a better academic improvement.
- We can conclude that the School Project was effective when discussing the topics the Carbon and Nitrogen Cycles.
- Learning strategies, like PBL, allow students to build their knowledge and change their misconceptions. They internalize the curricular concepts correctly and understand how scientific knowledge transforms the way they see the world.



# Sandra Beltrán

Francisco Gaztambide School  
School District: Bayamón

# Solid Waste Management Alternatives: The Hidden Energy

## Action Research Problem

Is the school project “Educate, Act, and Live” effective to improve the academic achievement of students in the concepts alternatives of solid waste management and alternative energy from solid waste biomass?



# Introduction

- In Puerto Rico and others countries, the excessive production of solid waste is a pressing issue. However, most of the citizens are not aware of this problem and only a few do effective practices of solid waste management.



## Justification

- Students presented the following difficulties:
  - Distinguishing between reuse, recycle, and reduce
  - Recognized the process of recycling as the only solution to address the problem of solid waste management
  - Believed that the only way to dispose organic matter is in a landfill
  - Didn't recognize waste as an alternate source of energy.

## Description

- Through the school project Educate, Act, and Live the students
  - Explained the differences between all solid waste management alternatives



# Description

- Through the school project Educate, Act, and Live the students
  - Built homemade models showing how to obtain energy from solid waste characterized as organic matter







# School Project: Human impacts on the urban area “El Pedregal” (rocky ground)

Minnette Rodríguez Harrison

Master Science Teacher UPR-RP

Benjamin Branoff & Christopher Nych

NSF - IGERT Fellows

e-mail: [mrhmonarca@gmail.com](mailto:mrhmonarca@gmail.com)

# Research Question

- Do twelfth grade students' learning about urban ecology improve by their participation in "El Pedregal" Project?



# Keywords

- ❑ *Ecology*
- ❑ *Human influences and impacts*
- ❑ *Urban ecology*
- ❑ *Conservation*



# Justification

- *Students' need to understand how their actions impact local urban ecosystems, how they can improve and change their city's ecosystem for the better, and how healthy urban ecosystems benefit their own lives (Barnetta, Vaughnb, Straussc & Cotterd, 2011)*
- *The four ways of knowing are understanding, doing, talking, and acting on science (Price, Pimentel, McNeill, Barnett & Strauss, 2011)*



# Sample

- *The research was conducted with a group of students from the Specialized School of Ballet Julián E. Blanco / San Juan School District*
  - *Environmental course*
  - *10 twelfth grade students (17-18 years old)*

# School Project “El Pedregal”

What is “El Pedregal?”

Stage  
#1

School Project  
Expectations

Stage  
#2

New beginning

Stage  
#3

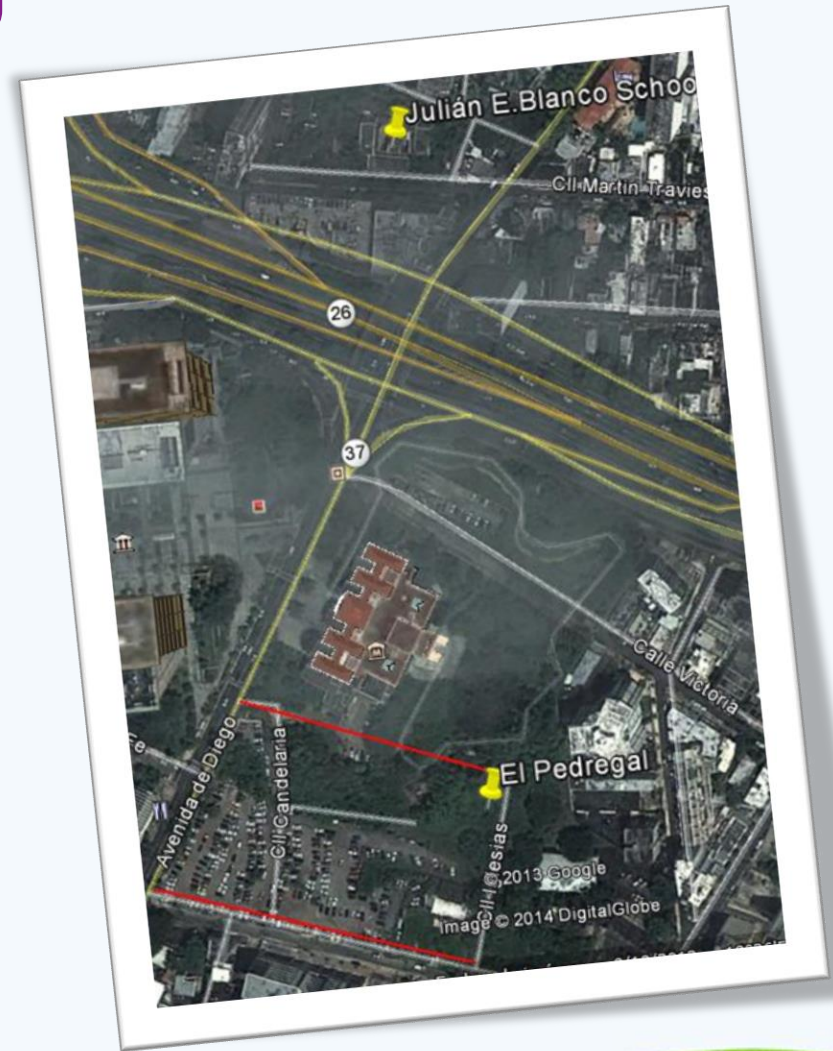
Students in action

Stage  
#4

Final presentation

# What is “El Pedregal?”

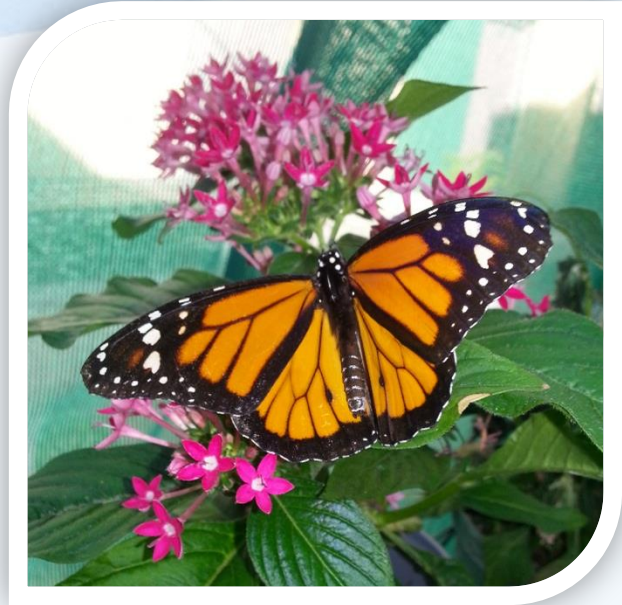
- Is a urban area near our school
- Every afternoon my students walk by this area to take their ballet class
- “El Pedregal” will be used as a learning in-situ laboratory for our school.
- San Juan does not have many green areas and “El Pedregal” will be a good option
- Actually, there is coalition to protect “El Pedregal”



Stage  
#1

School Project  
Expectations

- *First, students ideas included to plant the host plant of the monarch butterfly (we have a butterfly nursery in our school) on the urban area “El Pedregal”*
- *They wanted to collect long-term (LTER) data on larval monarch populations and milkweed habitat.*





Stage  
#2

## New beginning

- The owners of “El Pedregal” had different ideas to develop in this area
- We had to change our Project.
- Now, my students have a different perspective

Before



and

after



## Students Reactions

- Using the *one-five minute paper*, students wrote their reactions about the changes on “*El Pedregal*”

Al ver las imágenes del antes y el después sentí decepción porque ya habíamos pensado en lo que se pudo haber logrado con el proyecto del Pedregal, lo que ya se había comenzado y verlo destruido causa gran decepción.

“When I saw the pictures (before-after) I felt very disappointed, because we already had many plans and expectations with the School Project “El Pedregal” and the work we began to do was no longer there. (Student #1)”

Stage  
#3

Students in action

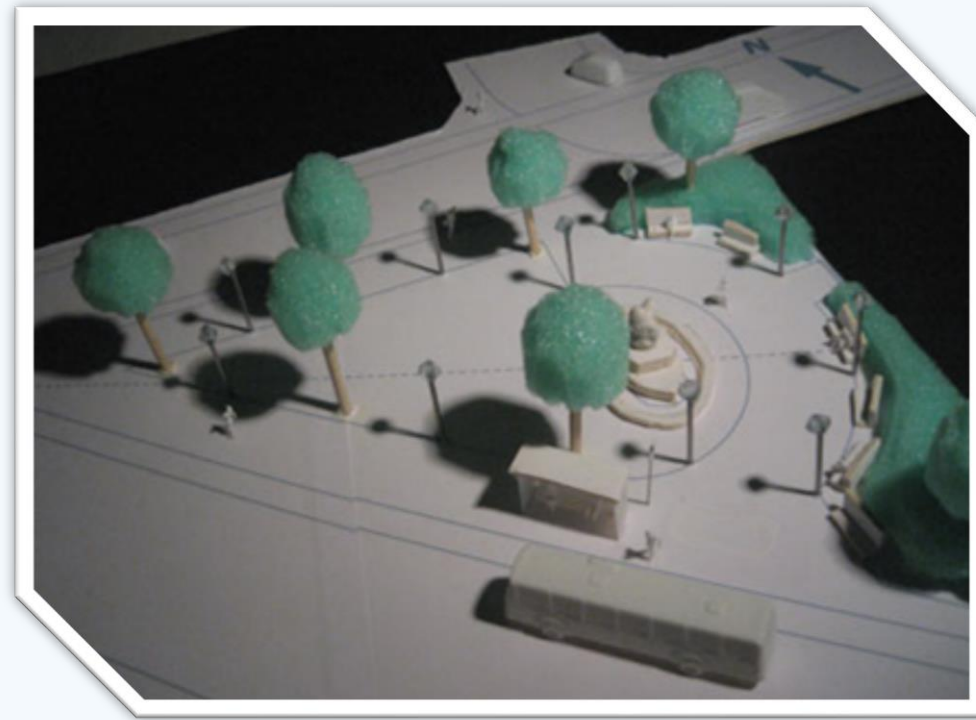
- The students wanted to see the changes in the area as a consequence of anthropogenic actions.
- This will allow them to identify if this land is viable to cultivate the monarch butterfly host plant.
- Google Earth Maps was one of the tools used.
- Interviews with experts that have worked in this area.



Stage  
#4

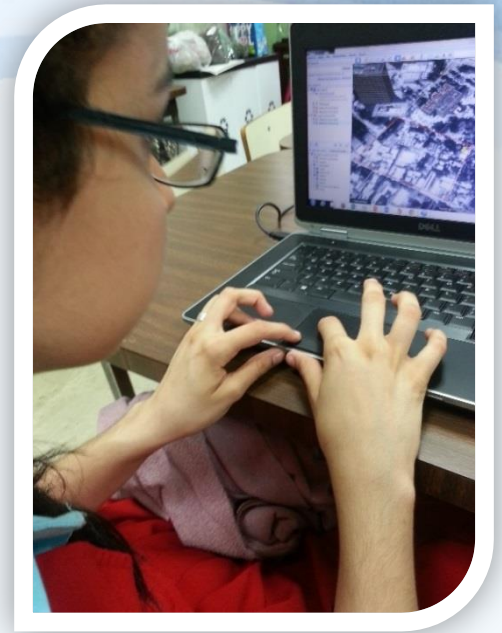
Final presentation

- *Students will design a urban physical model to demonstrate how they will like their city to look like in 10 or 20 years.*



# Strategies

1. *Cooperative groups*
2. *Using Google Earth and Google Maps*
3. *Continuous assessment*
  - *lessons (10)*
  - *one-five minute paper*
  - *field trips*
  - *pre and post test*
  - *urban physical model*



# First lessons

Unit: Ecology (review)

□ Principles of Ecology

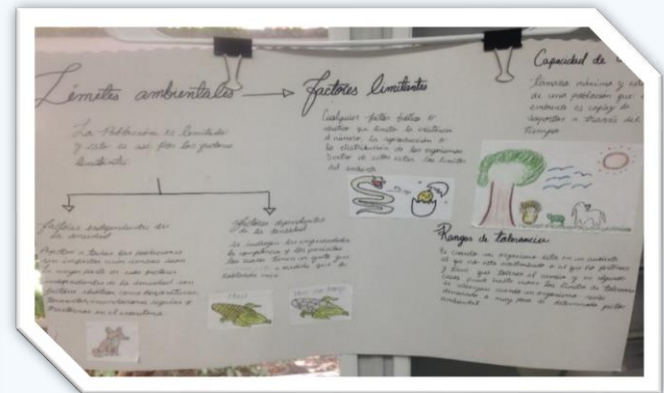
Biogeochemical cycles (compost)



Biological Community



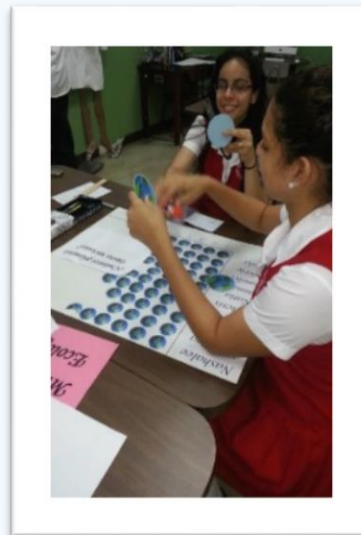
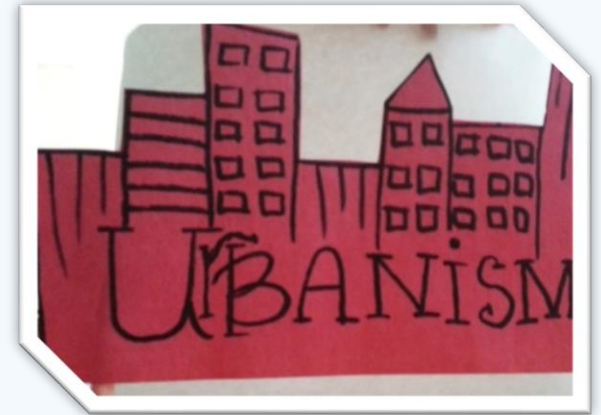
Ecological Succession



Population-limiting factors

# Urban Ecology Lessons

- ❑ Ecological Footprint
- ❑ What is urban ecology?
  - ❑ Characteristics of Urban Sprawl
  - ❑ Urban areas and urban problems
- ❑ Human Impacts
  - ❑ How patches change in space and time



# Urban Ecology Lessons (cont.)

- Acting on science
  - Litter Less Campaign (Eco School Program)
  - Urban physical model
    - how they will like their city to look like in 10 or 20 years.





# Data Collection

- ❑ *Pre/post test*
  - ❑ *Ten multiple choice questions on environmental science and urban ecology (including the use of maps)*
- ❑ *Rubrics (working on...)*
  - ❑ *Maps and urban physical model*



# Results

Students	Total Correct Answers (of 10 questions)	
	Pre-Test	Post-Test
1	6	6
2	6	8
3	6	7
4	4	4
5	6	4
6	10	10
7	3	9
8	10	8
9	4	9
Average	6.1	7.2

**Table 1.** Summary of nine individual student correct responses and group average for pre- and post-test.

# Pre- and post-test average results for nine students



**Figure 1.** Summary averages and standard error bars of number of correct answers for pre- and post-test results for nine students.

# DATA ANALYSIS

1. *The results were not proven statistically due to the small sample size, but it shows a trend that may be indicative of the potential effect of the lesson instruction and the use of the PBL strategy.*
2. *It is also possible that there actually was a significant increase in the level of understanding among all the students, but that the design of the test was not capable of demonstrating this change.*
3. *For future analysis I will consider redesigning the test items and include more rigorous methods.*

# Conclusions

- ❑ *The research showed that students improved their learning about urban ecology by their participation in “El Pedregal” Project.*
- ❑ *The students began to understand how their actions impact local urban ecosystems.*
- ❑ *This study complements the process of environmental literacy for our students.*



**CSMER**  
CENTER FOR SCIENCE AND MATH EDUCATION RESEARCH

# LIFE PROJECT

FOR PLANETARY EVOLUTION AND SUSTAINABILITY



## Natural Recycle Nutrients (Carbon and Nitrogen)

Jadira Aponte  
Alberto Meléndez Torres High School  
School District: Orocovis, PR

Ose Pauleus & Marianne Cartagena  
NSF-IGERT Fellows

Maximizing Yield Through Integration (MYTI-13) – Sponsored by NSF  
Award No. 1038166



# School Project



- Life Project is based on the educational strategy Problem Based Learning (PBL) to improve the student's academic achievement through an ecological laboratory.
  - The role of the student in *Life Project* is to be an active researcher that identifies solutions to environmental problems and improve our quality of life.
  - This lab had different settings: Compost, Garden, and Hydroponic, among others.
- Objective
  - Promote an urban and sustainable agriculture to minimize the shortage of food and organic waste from landfills.

# Action Research Question and Hypothesis



The impact of the *Life Project* in the academic achievement of high school students on the concept of Natural (Organic) Recycling in Urban Agriculture?

## Hypothesis

- Students improve their academic achievement, due to the impact of the activities related to the *Life Project*.



# Method



- We used a quasi-experimental research design (in the context) of Organic Recycling (Carbon and Nitrogen Cycles).
  - Control group = students who learn the concepts using traditional teaching.
  - Experimental group = students who learn the concepts participating in the *Life Project* activities.



# Method (cont.)



## Samples

- Two groups of twelve grade students:
  - 24 participants in each group
  - Both groups have the same amount of special education students

# Method (cont.)



## Data Collection

- Pre-test and post-test.
- Different assessment activities to discuss the following concepts:
  - Compost
  - Food chain
  - Biogeochemical Cycles (Carbon and Nitrogen)

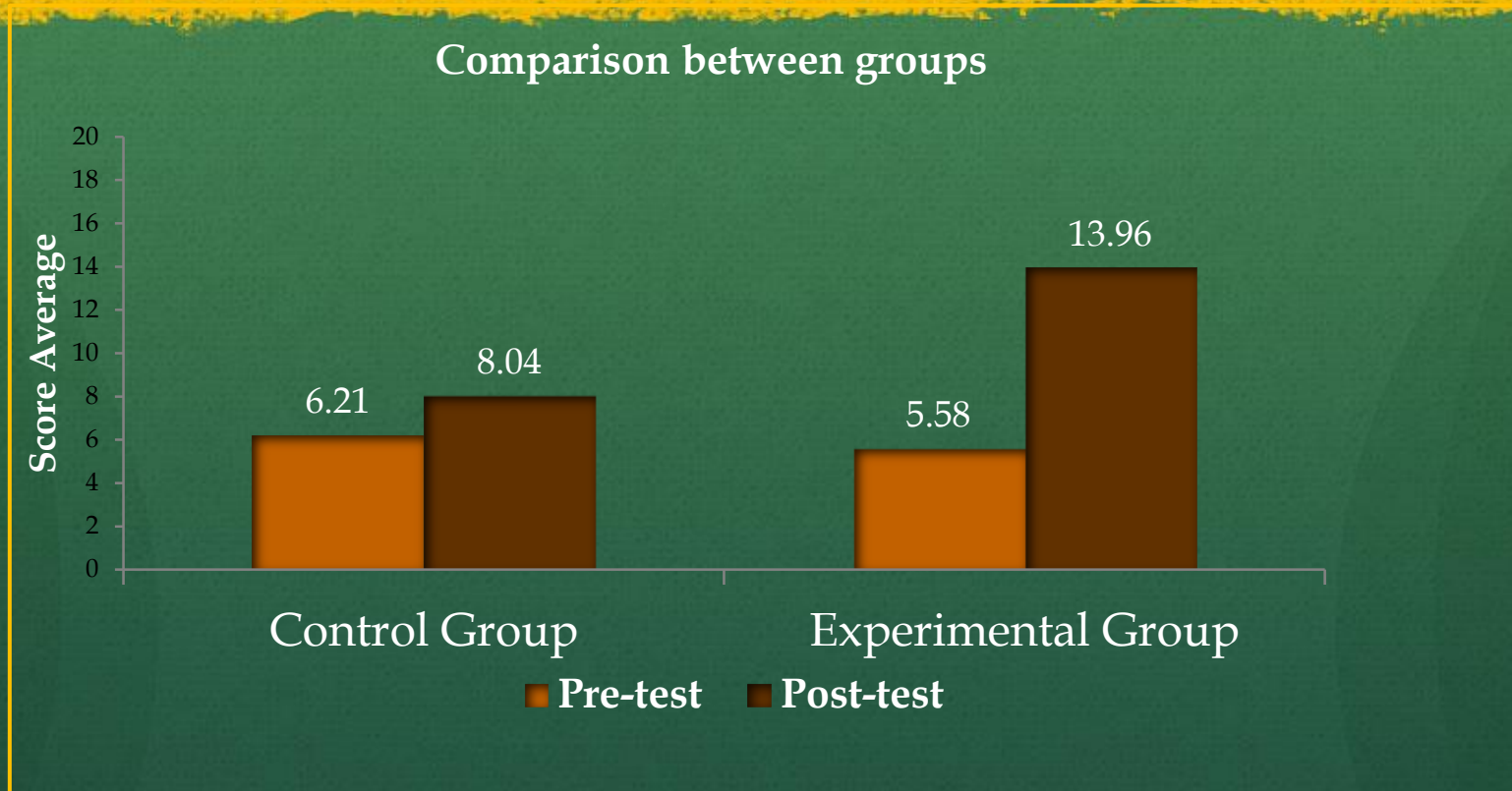


# Method (cont.)



- Statistic test
  - Covariance analysis was performed by using the general linear regression model
    - The dependent variable are the results of the post-test.
    - The covariate are the results of the pre-test.

# Results



- Shows an increase in the results obtained by students in the experimental group in the post test.
- There is a significant difference between the two groups ( $F=31.90$ ,  $p=0.000$ )

# Conclusion



- The results demonstrate that use of the activities in *Life Project based on the PBL* strategy are effective to increase the academic achievement of the students.
- We can improve the sustainable urban agriculture to decrease the food shortage and the amount of organic waste in landfills through environmental education using the PBL strategy.



# Transforming garbage to eat better

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**Marixa Rodríguez**

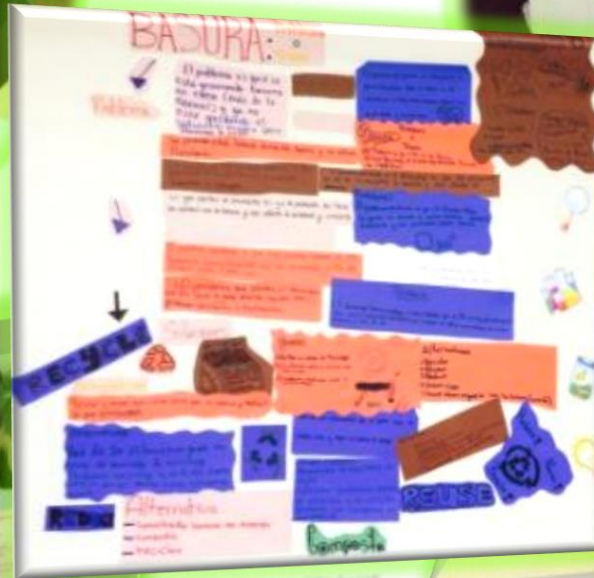
Science and Math Specialized School Brígida Álvarez Rodríguez  
School District: Vega Alta, Puerto Rico

Maximizing Yield Through Integration (MYTI-I3) – Sponsored by NSF  
Award No. 1038166



# SITUATION

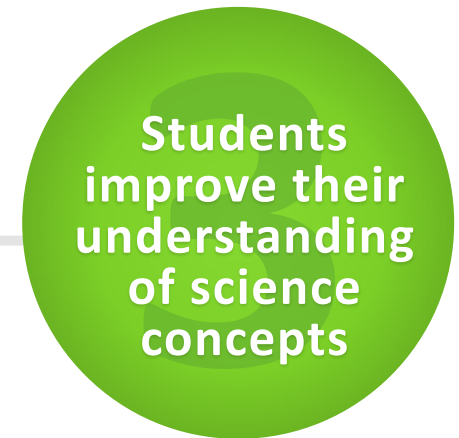
AFTER MANY POLITICAL DEBATES IF ALL PORTS IN PUERTO RICO ARE CLOSED NOTHING CAN BE IMPORTED AND EXPORTED. WHAT WE CAN DO?





# RESEARCH QUESTION

Does seventh grade students understanding of the concept “changes in matter” improve by participating the school project: Transforming garbage to eat better?



# METHODOLOGY

- A pre-experimental investigation
- Sample  
24 students of seventh grade.



# METHODOLOGY

- The students are working in their plan to identify solutions to the situation presented.
- This plan includes:
  - Production of compost
  - Design a school garden
- They will make flyers and videos to share what they have learned with their peers and community.



# DATA COLLECTION

- Pre/post test
- Assessment



# Conclusions

- At this moment the investigation is not concluded.



# Questions?

