Invitation Memo

DATE: 29 May 2013

TO: NASA Project Evaluators in Climate Education

FROM: Dr. Cherilynn A. Morrow, Senior Research Fellow, Aspen Global Change Institute (AGCI).
[NOTE: *My shepherding of this Concept Inventory is currently being supported by a sub-award to AGCI from Georgia State University (Atlanta, GA) – where I served formerly as Professor and PI of the parent NASA climate change education grant that was awarded in 2009.*

RE: Request to Review and/or Pilot Test the Emerging *Concept Inventory for Climate Change*

This PowerPoint presentation introduces the development process and current characteristics of an emerging *Concept Inventory for Climate Change* for your consideration. *The PPT is a refined version of the one presented to NASA project evaluators on a WebEx call convened by Dr. Ann Martin on 17 Mar 2013.*

NASA project evaluators for climate education projects are among a ***select group of professionals*** whom we are inviting to participate in our **final round of expert review. Please do not forward this invitation.** If there is a colleague we missed whom you would like us to invite, please consult with us to arrange this.

On the **last slide** there is a web link to an **on-line survey** that facilitates your review of our research-based instrument. **This web link is for NASA project evaluators only**. It will take between **20 and 60 minutes** to complete depending on the time you are able to devote (Dr. Martin reported **40 minutes** for her thorough review). Your time and expertise is deeply valued and, with your permission (and a completed survey), you will be gratefully acknowledged in our presentations and publications. If you cannot complete the survey in one sitting, you **can re-enter and continue where you left off** (using the same computer).

We are also seeking new partners to expand the testing of the instrument. Please let us know if you or a colleague might be interested in this possibility.

Thank you for your time and interest!

C. Morrow - cmorrow@agci.org

NASA Innovations in Climate Change Education (NICE)

Introducing a Concept Inventory for Climate Change (CICC)

(VERSION for BROADER DISSEMINATION)

Cherilynn A. Morrow, John Katzenberger
Comfort Afolabi, Judith Monsaas

Presentation for NICE Project Evaluators

17 May 2013

WebEx convened by
Dr. Ann M. Martin, NICE Program Evaluator

OUTLINE

1. Introduce Team on Phone
2. Share Philosophy of “Testing”
3. Introduce NASA Project and Motivation for Concept Inventory
4. Introduce Context of Research
5. Summarize Development Process
6. Introduce Instrument
7. Offer a TASTE of LESSONS LEARNED and data driven changes to text and GRAPHICS
8. Introduce Survey Monkey Questionnaire about the Concept Inventory
9. Your Input Please?

Core Development Team

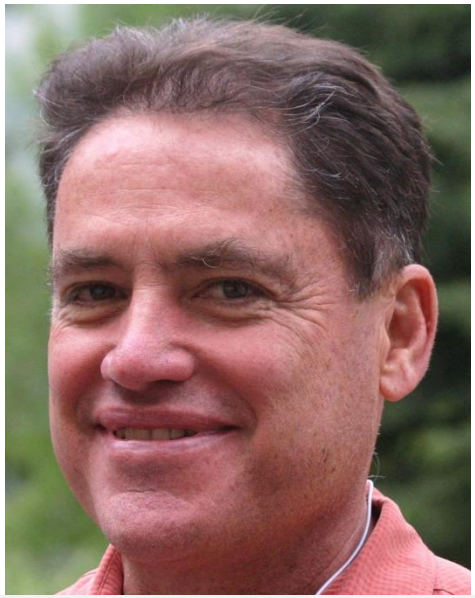
Dr. Cherilynn Morrow
Science Education Research

Senior Research Fellow
Aspen Global Change Institute

Dr. Judy Monsaas
Psychometrics

Executive Director of
Assessment and Evaluation
University System of Georgia

John Katzenberger
Science Expertise



Executive Director
Aspen Global Change Institute

Research Specialist, GaPSC

Dr. Comfort Afolabi
Data Collection & Analysis

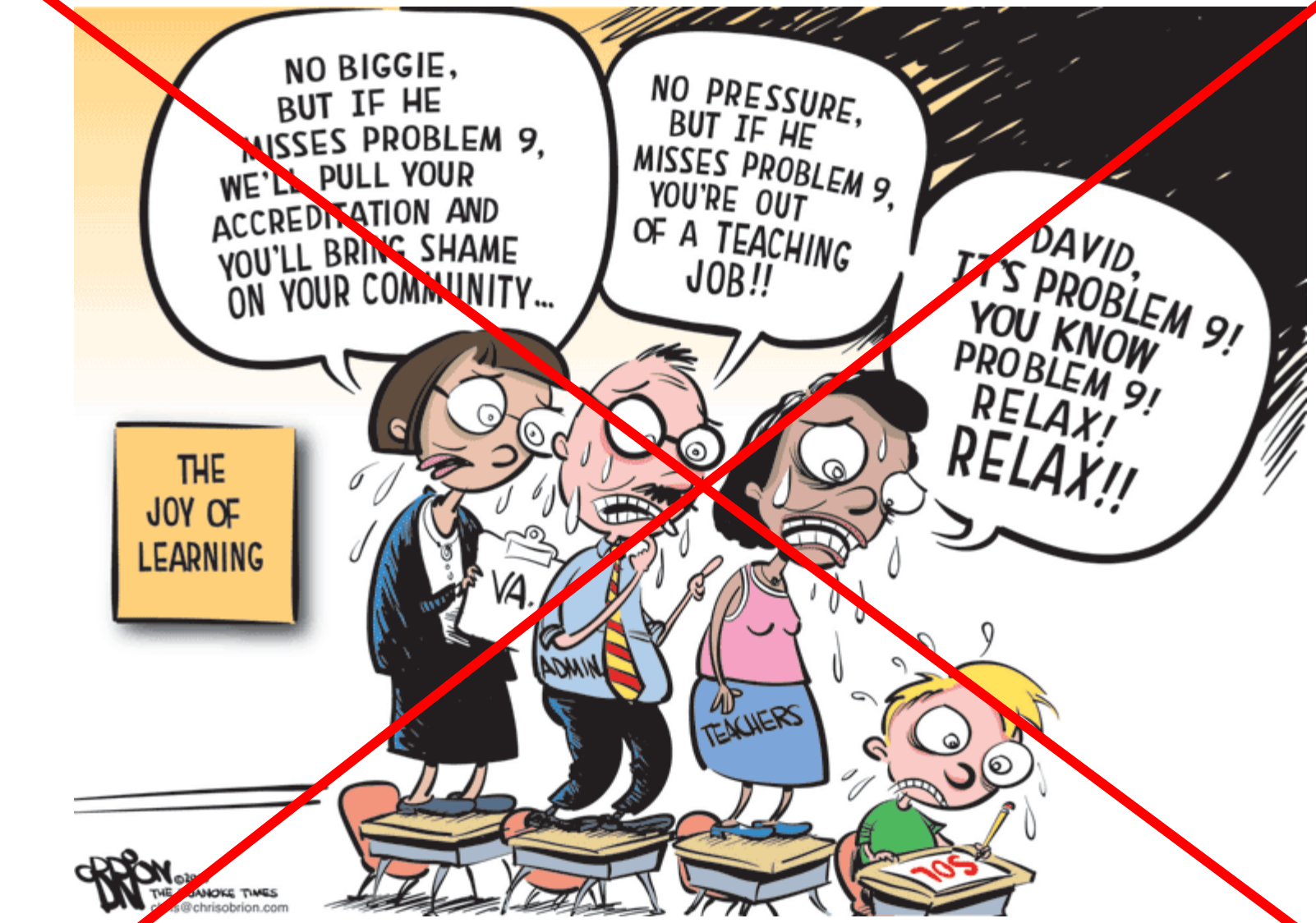
Our Project Evaluator

Dr. August Ogletree

She who will evaluate our efforts to create the Concept Inventory and to achieve other project goals.

PhD, Educational Policy Studies.
Emphasis in research, measurement and statistics.

Retrieved from http://www.newsknowhow.org/news-post/156



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The Intended Use of a Concept Inventory

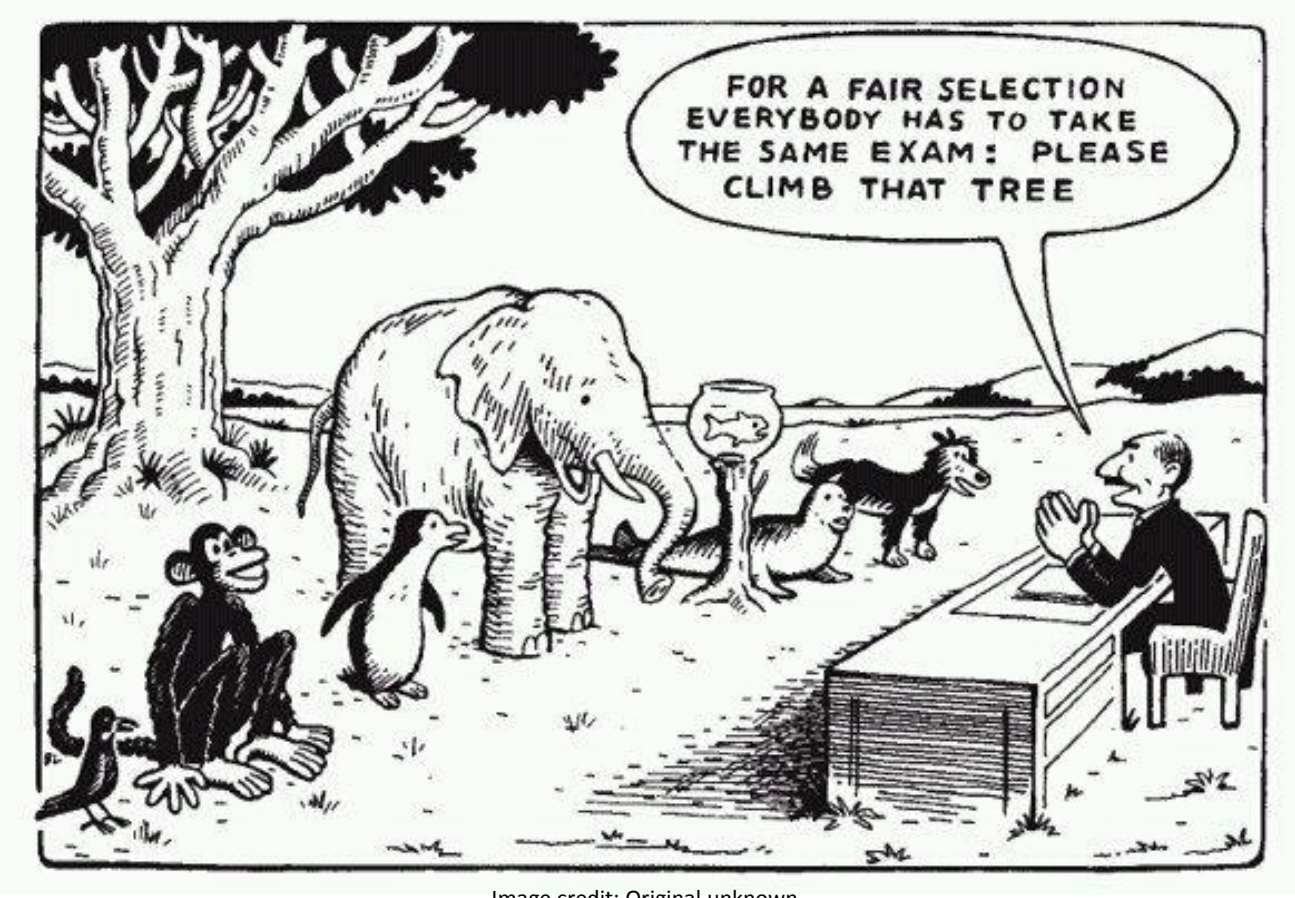


Image credit: Original unknown.
Retrieved from http://scienceblogs.com/startswithabang/2012/06/20/make-the-next-school-year-amazing-for-your-students/

Now testing is important: Standardized tests have a place. But they should not be the dominant culture of education. They should be ***diagnostic***...they should help... [to determine if indeed learning is taking place when one is teaching].

- Sir Ken Robinson, TED Talk, April 2013

Intended Use of Concept Inventory

A *multiple-choice* test cannot purport to assess deep conceptual understanding but if well developed, a multiple choice concept inventory can…

1. ***flag*** conceptual issues (PRE-instruction).
2. ***detect*** conceptual change (POST-instruction).
3. ***inform*** decisions about teaching strategies.
4. ***all of the above***.* ☺

In higher education (notably introductory physics), a concept inventory used as described above has proven to play an important role in transforming teaching practices among STEM faculty.

☺ This is NOT a *best-practice* structure for an item, but it serves the intended purpose here.

NASA GCCE Award to Georgia State

Awarded in 2009

TITLE: *Creating an Enduring Legacy of Exemplary Global Climate Change Education for Secondary Science Teachers and Underserved Students in Georgia*

GSU INVESTIGATOR TEAM:

PI: Dr. Cherilynn A. Morrow, Professor, Physics & Astronomy

~~Co-I: Dr. Lisa Martin-Hansen, Assoc Professor, MSIT, C of Ed~~

Co-I: Dr. Jeremy Diem, Assoc Professor, Geosciences

Co-I: Dr. W. Crawford Elliott, Chair, Geosciences

NASA award remains at Georgia State
Sub-award to Aspen Global Change Institute

Configuration from Aug 2012 to present

TITLE: *Creating an Enduring Legacy of Exemplary Global Climate Change Education for Secondary Science Teachers and Underserved Students in Georgia*

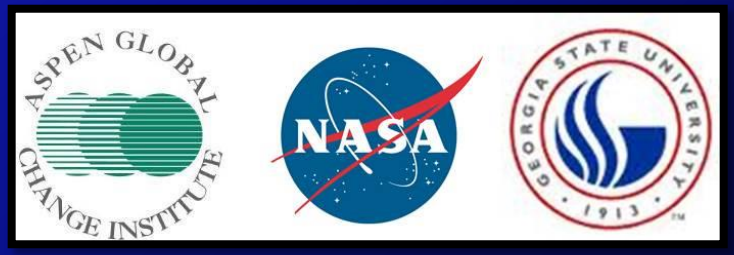
GSU INVESTIGATOR TEAM:

PI: Dr. W. Crawford Elliott, Chair, Dept. of Geosciences, GSU

Co-I: Dr. Brett Criswell, Assistant Professor, MSIT, C of Ed, GSU

Co-I: Dr. Jeremy Diem, Associate Professor, Geosciences, GSU

Co-I: Dr. Cherilynn A. Morrow, Aspen Global Change Institute



One of the Project's Primary Goals is…

to improve the labs of a popular 4-credit course called "Introduction to Weather & Climate (GEOG 1112) by

a. infusing NASA global climate change resources [EASIER];

b. applying best pedagogical practice [HARDER in higher education] .

GEOG 1112 in Georgia is…

1) a multi-disciplinary INTRODUCTORY course on weather and climate;

2) a 4-hour laboratory course allowing integration of NASA resources and more CLIMATE CHANGE topics in the labs;

3) not particularly mathematical;

4) very popular among undergraduates at GSU for satisfying core science requirements in Arts & Sciences (~950 students per year, including summer semesters); and

5) often taken by teachers in a Masters of Arts in Teaching (MAT) program during the Maymester (3 weeks summer).

Sample GEOG 1112 Demographics

Spring 2013 Semester N ~ 360

- ~63 % Freshmen or Sophomores
- ~13 % STEM majors
- ~14 % Education or Communication majors
- ~44 % < 20 years of age
- ~57 % Female
- ~38% White; 38% Black; 13% Asian; 9% Hispanic

Discovering the Broader Need & Opportunity Concept Inventory for Climate Change

1. We looked around and did not find a suitable assessment tool to help validate student learning in the new GEOG 1112 labs.
2. We learned about the Climate Literacy document and the AAAS efforts to develop a bank of items for K-12 use at multi-agency PI meetings and national conferences.
3. We saw the need and the opportunity to develop an instrument of community-wide value (stirred by prior experiences in Physics Education Research (PER) and formal participation in a review of NAEP items).
4. In 2011, (then PI) Morrow received NASA approval to adjust our project work and put more emphasis on developing a Concept Inventory.

Summary of Development Process (as of mid-May 2013)

1. Scientific and educational reviews of all drafts
2. Administration of 8 evolving versions of the Concept Inventory in multiple GEOG 1112 classes – added the participation of two smaller Georgia institutions this Spring (i.e., Kennesaw State U. and U. West Ga).

   18 classes. 40 administrations of pre and/or post.
   ~1200 students have experienced a version of the instrument

3. Student group interviews invited immediately after administration of the instrument in a class – VERY FRUITFUL. ~50 students engaged in small group settings (1-8 people). [***COMMENT:*** *Eyes of science-trained, education-savvy Morrow are opened to value of qualitative research methods. She finds that facilitating "think-aloud" group interviews is kindred to leading inquiry in the classroom. Statistics (see below) help to flag psychometrically-challenged items. Interviews help tell what to do to improve the items. Both disciplinary and pedagogical content knowledge are essential to conduct the interviews.*]
4. Statistical analyses (item frequencies, item difficulty, item discrimination statistics, reliability coefficient for instrument)

Core Development Team

We are addressing gaps between our disciplines to benefit fully from our combined expertise.

Dr. Cherilynn Morrow
Science Education Research

Senior Research Fellow
Aspen Global Change Institute

Dr. Judy Monsaas
Psychometrics

Executive Director of
Assessment and Evaluation
University System of Georgia

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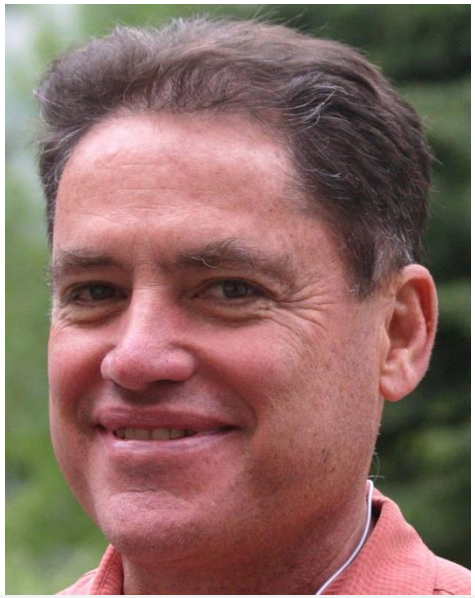
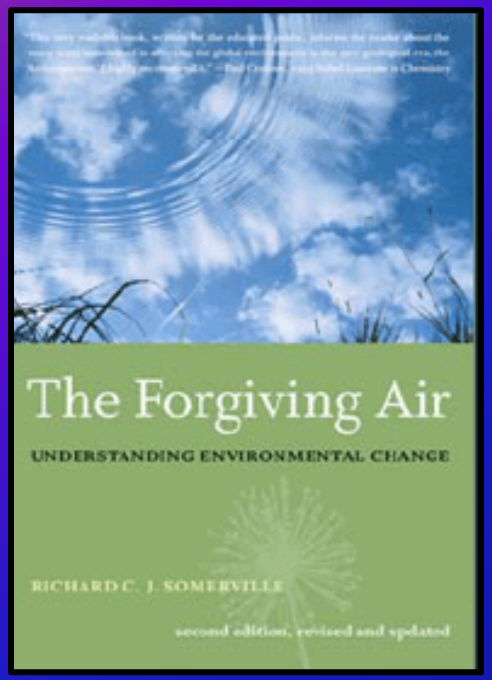


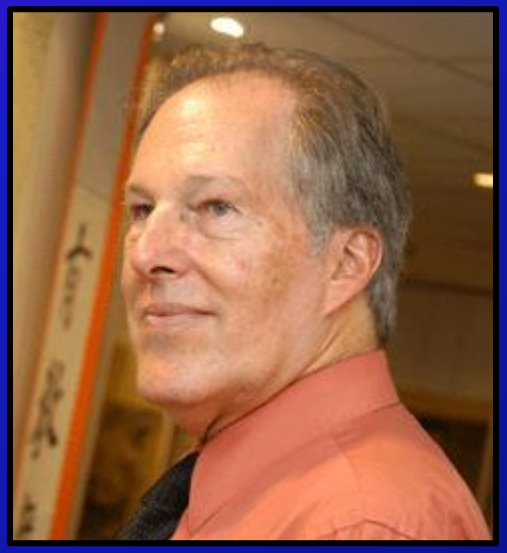
Executive Director
Aspen Global Change Institute

Research Specialist, GaPSC

Dr. Comfort Afolabi
Data Collection & Analysis

Dr. Richard Somerville – Science Consultant



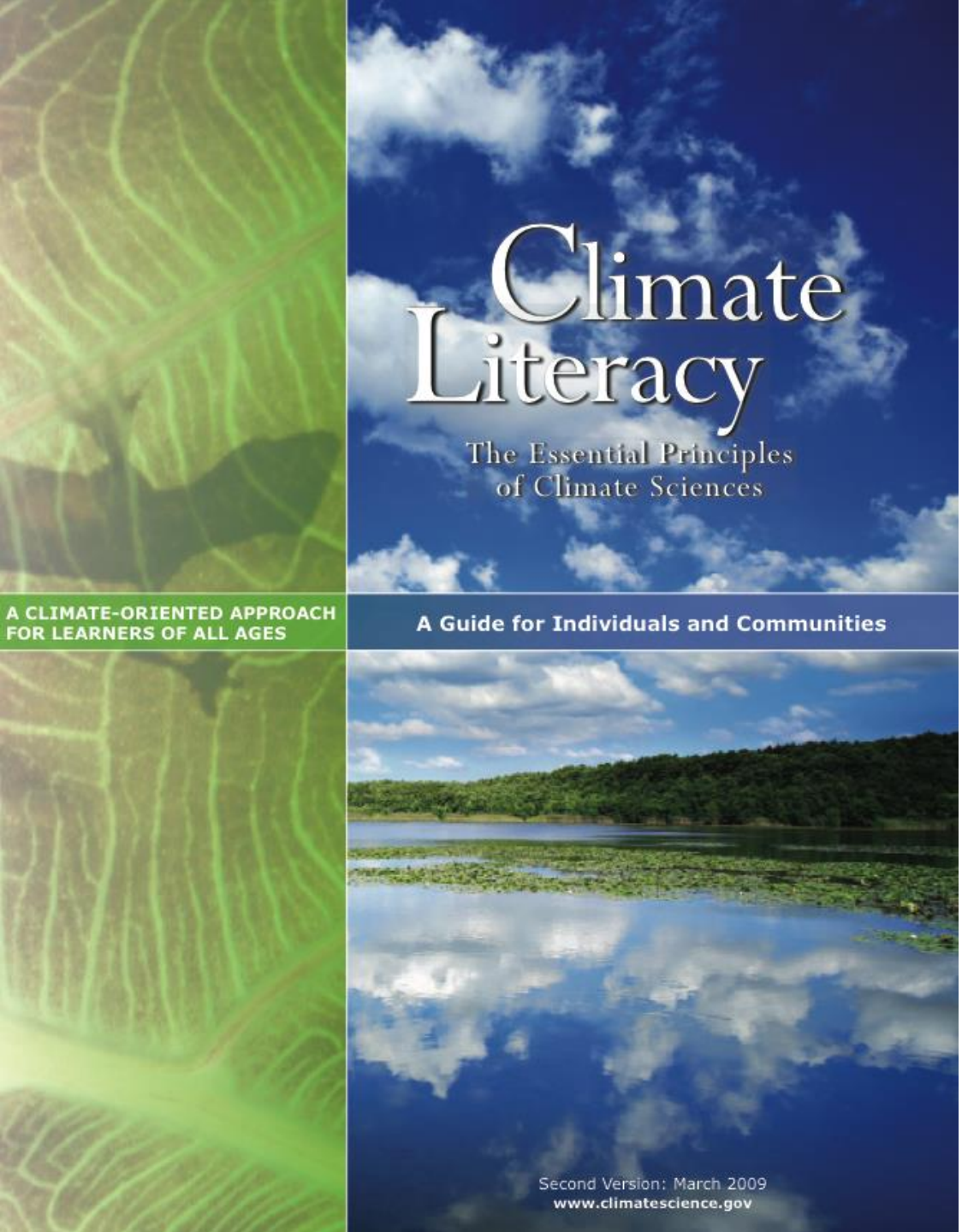


- Dr. Somerville is a world-renowned climate scientist and IPCC* leader. He is also author of *The Forgiving Air* – an award-winning book derived from a series of lectures he provided for a teacher professional development project. He visited us in Atlanta **17–21 January 2010.** [*IPCC = Intergovernmental Panel on Climate Change]
- Data we collected at his emphatically "straight science" talk suggested shifting attitudes toward more willing consideration of scientific perspectives. This result influenced the language of our items. We took care to cite "how we know" wherever possible.

Our developmental process has evolved and matured with time.

- First IRB approved in May 2011
- Hired Comfort Afolabi as grad assistant

Administration	Summer 2011	Fall 2011	Spring 2012	Fall 2012	Spring 2013	TOTAL
Pre	53	N/A	267	486	428	1234
Post	48	93	253	428	362	1184



CONTENT VALIDITY

Our content validity derives predominantly from the national consensus document entitled:

"Climate Literacy: The Essential Principles of Climate Science".

http://www.climatescience.gov/Library/Literacy/

Climate Literacy Principles

Endorsed by Twelve Federal Agencies plus National Partners

UCAR, NCAR,
CIRES, AMS, TERC,
GLOBE program,
College of Exploration,
ESIP federation, ASTC IGLO,
LHS, AAAS Project 2061,
NAAEE

Example Sources of Stimulation for Item Generation

Our item generation has been stimulated by other key sources in addition to the *Climate Literacy Principles,* but all items are grounded in those *Principles*:

1. Content of NASA Labs for GEOG 1112 - early conversations with lead Co-I for lab development regarding assessment items;
2. Observations of students doing the NASA labs (for evaluation purposes);
3. AAAS Atlas for Weather and Climate – linked to *Climate Literacy Principles;*
4. Intergovernmental Panel on Climate Change (IPCC) Physical Science FAQ;
5. Somerville & Hassol – Physics Today article on Climate Communication;**
6. NAEP – released items 2009 and 2012 , Physical, Earth & Space Science;**
7. Questionnaire whose analysis resulted in the *Six Americas* Report; and
8. Research papers on misconceptions (e.g. Buhr & McCaffery 2008 in *Physical Geography*, Shepardson et al. 2010 in *Climatic Change).*

** = focus of commentary in oral presentation

Concept Inventory for Climate Change Content Validity

- The CICC endeavors to offer a valid approach to a first-order assessment of literacy about CLIMATE CHANGE as opposed to literacy about the broader domains of weather and climate science.

- However, the instrument ALSO includes a subset of basic weather and climate concepts that support understanding of climate change and its consequences.

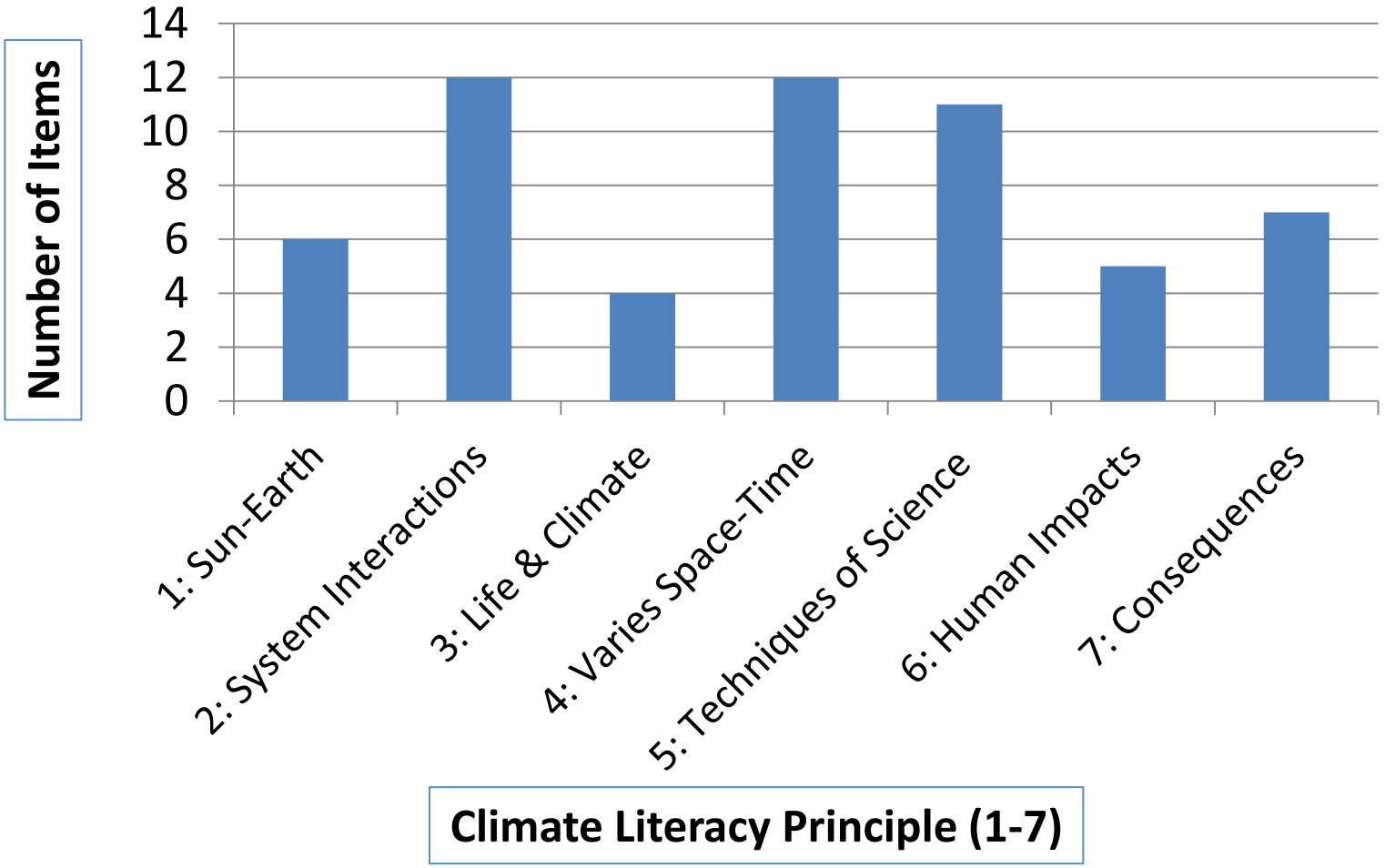
CURRENT Instrument Characteristics
Spring 2013 POST - V.8h2

- 36 multiple choice items [**NOTE**: probably needs to be less]
- Distribution of content by *Climate Literacy Principle* – Each item keyed to relevant Principles
- Item structure in accordance with standard best practices
- About 1/3 each: Knowledge, Comprehension, Application
- Distribution of item difficulties [***NOTE**: What is EASY in Boulder, might not be EASY in Atlanta.*]

Distribution of Item Content

36 Items keyed to 7 Climate Literacy Principles

4 items keyed to 3 Principles; 12 items keyed to 2 Principles



DRAFT Coding for Sub-scoring Validation

To be explored via factor analysis

1. Basic Weather & Climate (BWC)
2. Systems, Cycles, Feedbacks (SYS-CYC)
3. GH Effect & CO2 Literacy (GH-CO2)
4. Consequences of Climate Change (CONSQ)
5. Scientists on Climate Change (SoCC)

- Each item has ONE or TWO TAGS from the list above
- Some items have flags for:

  Physical Science, *Life Science*, and *Math*

COMMENT: *Currently we are choosing not to explore the Climate Principle categories as sub-scoring groups because, for example, Life & Climate (Climate Principle #3) items involve disparate knowledge (e.g., about photosynthesis, migrating infectious diseases, ocean acidity, etc.) and so might not be expected to correlate well.*

Concept Inventory for Climate Change

Classifying by "Cognitive Type"

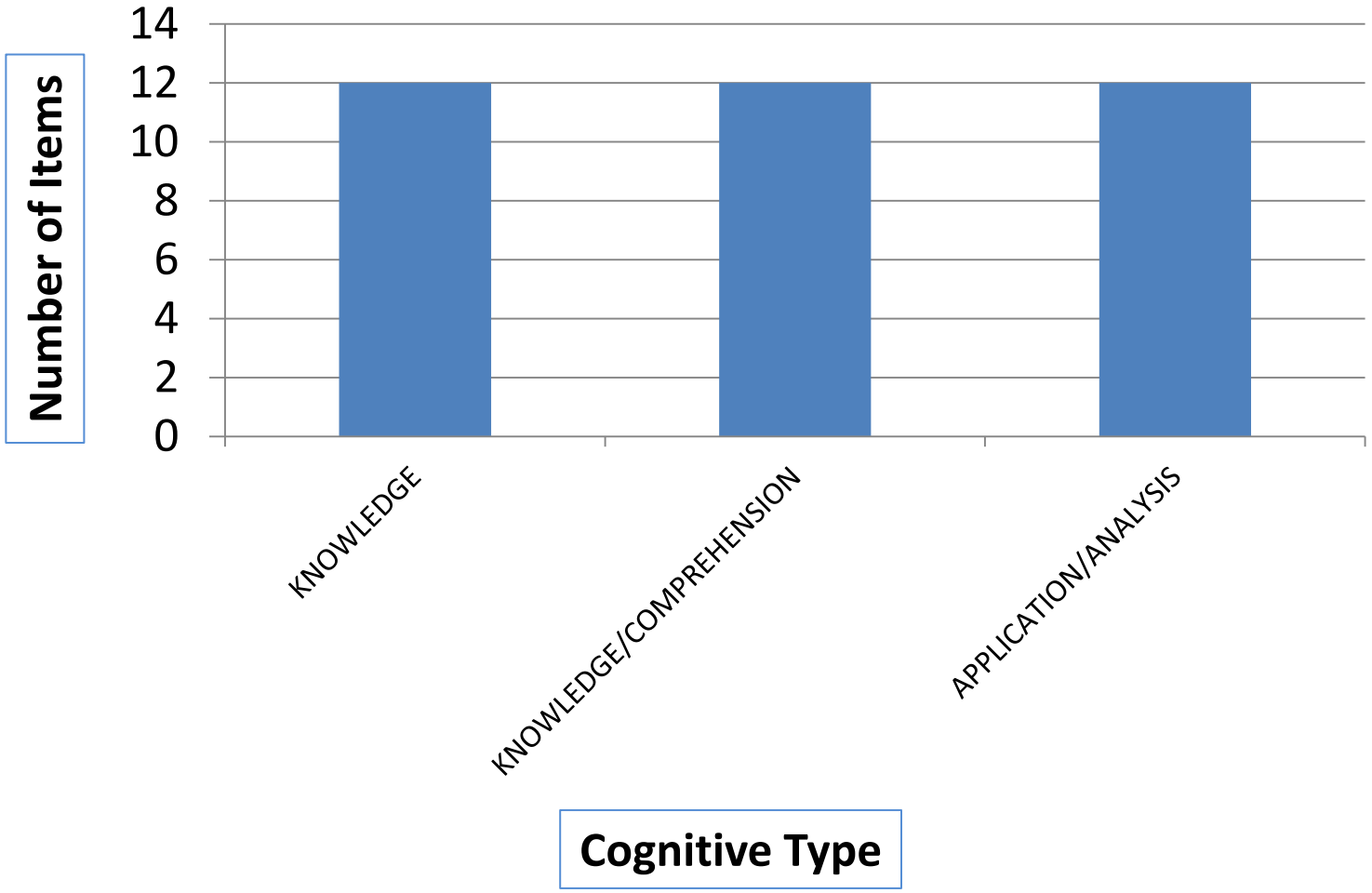
Each item is rated on a 3-tier scale of the cognitive sophistication the item is calling for. As *currently* classified, the CICC contains about one third of each sort of item:

[K] = Knowledge - asks for knowledge of a fact or definition

[K/C] = Knowledge/Comprehension - requires more conceptual understanding to answer correctly.

[A/A] = Application/Analysis - asks for application of underlying concept to answer correctly.

Distribution of Cognitive Type
(Subject to further review – Yours please!)



Concept Inventory for Climate Change
Classifying by Cognitive Level

1. Climate scientists and research meteorologists distinguish between "weather" and "climate". Which statement is more about the *climate* of a town?

A. The high temperature today was 30°C (86°F).

B. Ten centimeters (Four inches) of rain fell on 18 September 2010.

C. The high humidity this past week has been very unpleasant for working outside.

D. The average yearly snowfall is 218 centimeters (86 inches).

POLL: Which TYPE of item would you say this is?

K K/C A/A

[K] = Knowledge - asks for knowledge of a fact or definition
[K/C] = Knowledge/Comprehension - requires more conceptual understanding to answer correctly.
[A/A] = Application/Analysis - asks for application of underlying concept to answer correctly.

Concept Inventory for Climate Change
Attentive to Cross-talk among Items

1. Climate scientists and research meteorologists distinguish between "weather" and "climate". Which statement is more about the *climate* of a town?

A. The high temperature today was 30°C (86°F).

B. Ten centimeters (Four inches) of rain fell on 18 September 2010.

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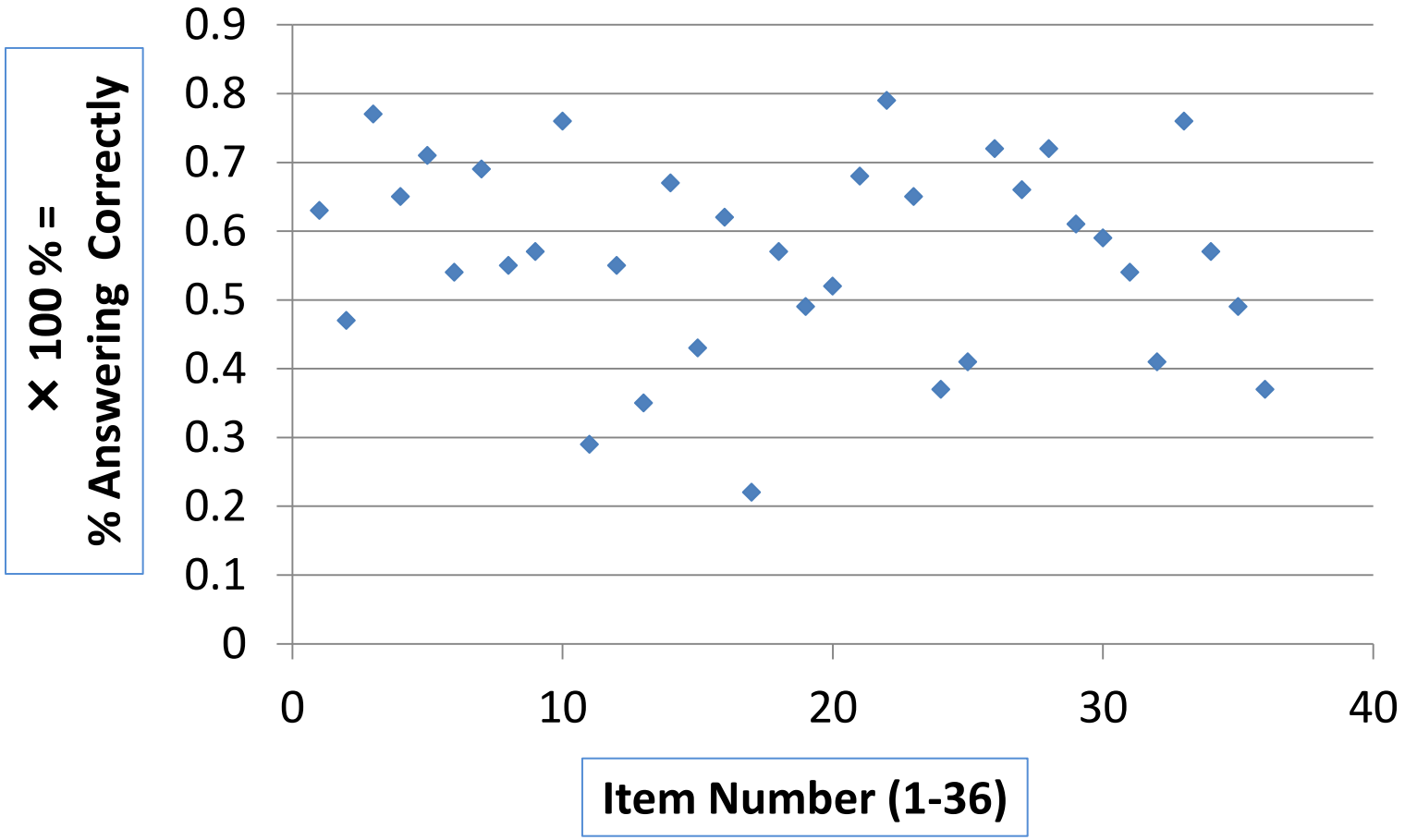
Some Recent Item Frequencies

SP2013 PRE: [17, 3, 33, 47*]
SP2013 POST: [9, 6, 21, 64*]
FA2012 POST: [6, 3, 10, 80*]

- NOTE for SP2013 PRE & POST the attraction of answer choice **C** about HUMIDITY.
- Comparing the two POST-tests: The instrument for SP 2013 POST, had a modified, more difficult ITEM 2 about distinguishing weather & climate compared to the instrument for FA2012 POST. The previous ITEM 2 for FA2012 POST (80% correct on ITEM 1) most likely ***better informed*** the answer to ITEM 1 compared to the modified ITEM 2 for SP2013 POST (64% correct on ITEM 1). Delete ITEM 1 or ITEM 2?

Distribution of Item Difficulties

Spring 2013 **POST** - V.8h2, N ~ 360



Concept Inventory for Climate Change

Climate Models – Not as Easy as We Might Think

We've learned that it is important for the sub-stem to refer to the stem.

4. One of the many ways scientists use "climate models" is to make projections about how climate would change if the amount of greenhouse gases in the atmosphere were changed.

In the context above, the term "climate model" means…

A. a computer-based simulation of the climate system based on the laws of science.

B. an example of a highly desirable climate.

C. the same as a climate zone (e.g. Tropical, Temperate, or Polar).

D. a mechanical scale model that shows how the Sun relates to Earth and its atmosphere.

RECENT ITEM FREQUENCIES (%)

SP2013 PRE #5: [66*, 4, 3, 27]
SP2013 POST #4: [65*, 3, 11, 22]
FA2012 POST #4: [61*, 6, 19, 13]

- Note attraction to **D**.
- Attraction to **C** is likely introduced by hearing the terminology in the course

The Mantra of Good Item Development

The mantra of good item development is:

The student who understands, gets it right:

The student who doesn't understand, gets it wrong.

ALSO not as easy as one might think….

THE STUDENT…	Get's Item RIGHT	Get's Item WRONG
KNOWS	☑ **YES!**	☒ NO (student is fooled)
DOES NOT KNOW	☒ NO (student guesses right)	☑ **YES!**

Concept Inventory for Climate Change

Some Effects of Science & Education Review plus Psychometric Analysis & Interviews

24. Which human activity does NOT increase the amount of carbon dioxide in the atmosphere?

A. Using chemicals that deplete the ozone layer

B. Burning fossil fuels (i.e. coal, oil, and natural gas) for heat and electricity

C. Clear cutting forests or jungles

D. Driving cars and trucks

Fall 2012 PRE - V.5f

18. Three of the human activities listed below release a large amount of <u>carbon dioxide</u> *directly* into the atmosphere. Which activity does <u>NOT</u> do this?

A. Operating a coal-fired power plant (A boiler burns coal and converts the heat energy to electricity.)

B. Operating a nuclear power plant (A reactor splits atoms and converts the heat energy to electricity.)

C. Clear cutting and burning forests and jungles

D. Driving gasoline or diesel fueled cars and trucks

Spring 2013 POST - V.8h2

The Effects of Interviews on **Text**

Example from **Early** Version of Concept Inventory

1. **The insert in the graph above labeled "Annual Cycle" shows a close up of the timing of the up and down variations around the rising line. Notice that the amount of carbon dioxide in the atmosphere is higher at certain times of year, and lower at other times of year. What is the best explanation for why the amount of carbon dioxide in Earth's atmosphere is rising and falling like this each year?**

   A. Most people live in the northern hemisphere where there is more land mass. They travel in cars and planes more in the northern hemisphere summer months, thus causing higher amounts of atmospheric carbon dioxide in the summer and lower amounts in the winter months.

   B. Most people live in the northern hemisphere where there is more land mass. They burn more fossil fuels for heating in the northern hemisphere winter months, thus causing higher amounts of atmospheric carbon dioxide in the winter and lower amounts in the summer months.

   C. There is more land mass for vegetation in the northern hemisphere. Thus in the northern hemisphere spring, after a time of less vegetation in the winter, atmospheric carbon dioxide is lowest. In the fall, after a summer of more vegetation, atmospheric carbon dioxide is highest.

   D. There is more land mass for vegetation in the northern hemisphere. Thus in the northern hemisphere fall, after a time of more vegetation in the summer, atmospheric carbon dioxide is lowest. In the spring, after a winter of less vegetation, atmospheric carbon dioxide is highest.

Spring 2012 - V.4d

The Effects of Interviews on Text

Example from **Latest** Version of Concept Inventory

The content objective is the same as for the item on the previous slide.

24. The annual "wiggles" in the graph above show that the atmospheric concentration of carbon dioxide (amount of CO_2 measured in ppm = *parts per million*) naturally *varies* up and down by about 7 ppm. Which statement best explains this *variation*?

As the Spring/Summer growing season begins, photosynthesis causes the CO_2 concentration to...

A. decrease (as growing vegetation *takes in* more CO_2), and then **CO_2** levels go up in Fall/Winter.

B. increase (as growing vegetation *releases* more CO_2), and then **CO_2** levels go down in Fall/Winter.

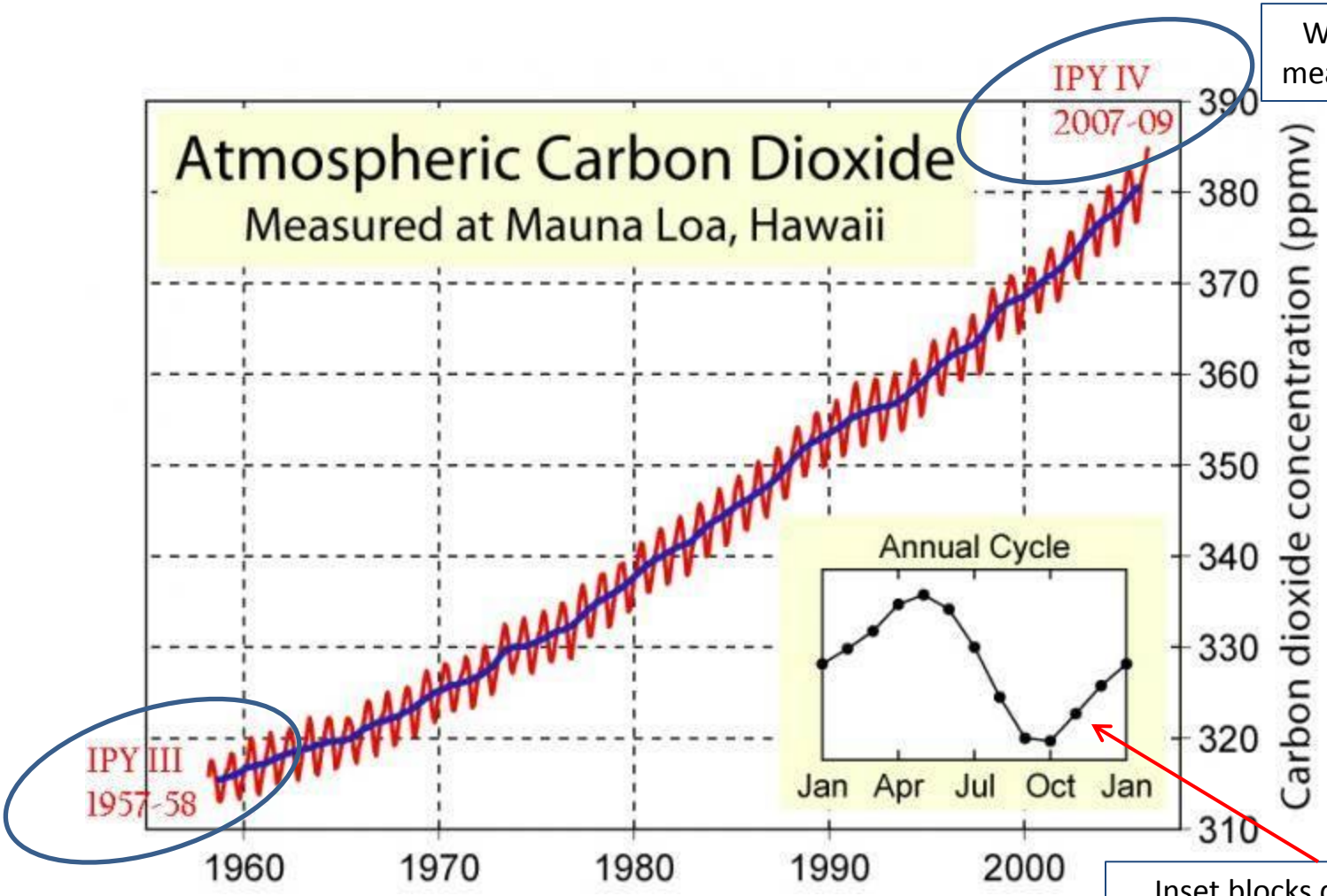
C. decrease (as growing vegetation *takes in* more CO_2), and then **CO_2** levels go up the following Spring.

D. increase (as growing vegetation *releases* more CO_2), and then **CO_2** levels go down the following Spring.

Maymester 2013 PRE/POST - V.9g2

The Effect of Interviews on **Graphics**

Example #1 – Keeling Graph of Atmospheric CO_2 Concentration

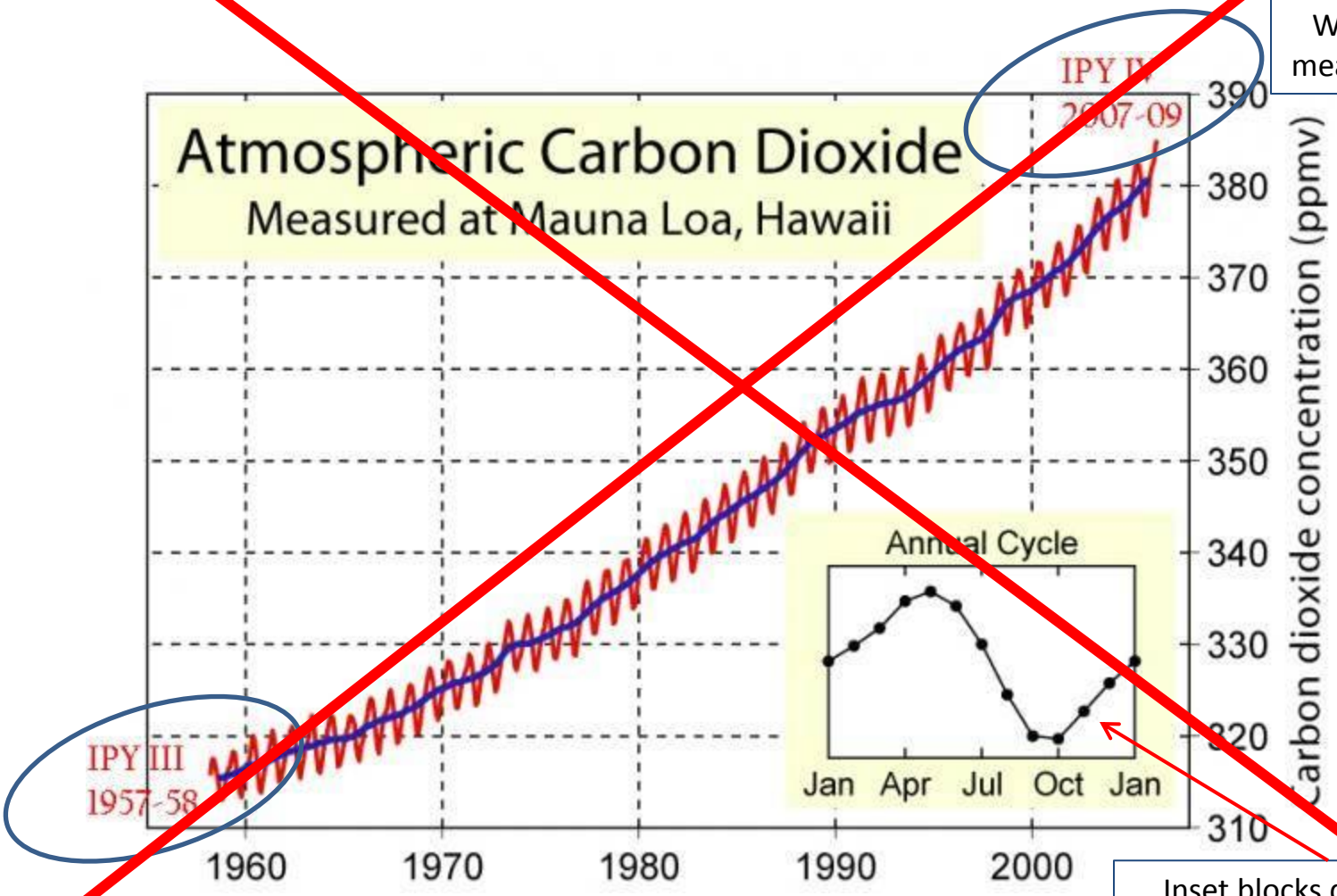


What does this mean? Distracting

Inset blocks quantitative readability of primary curve

The Effect of Interviews on **Graphics**

Example #1 – Keeling Graph of Atmospheric CO_2 Concentration

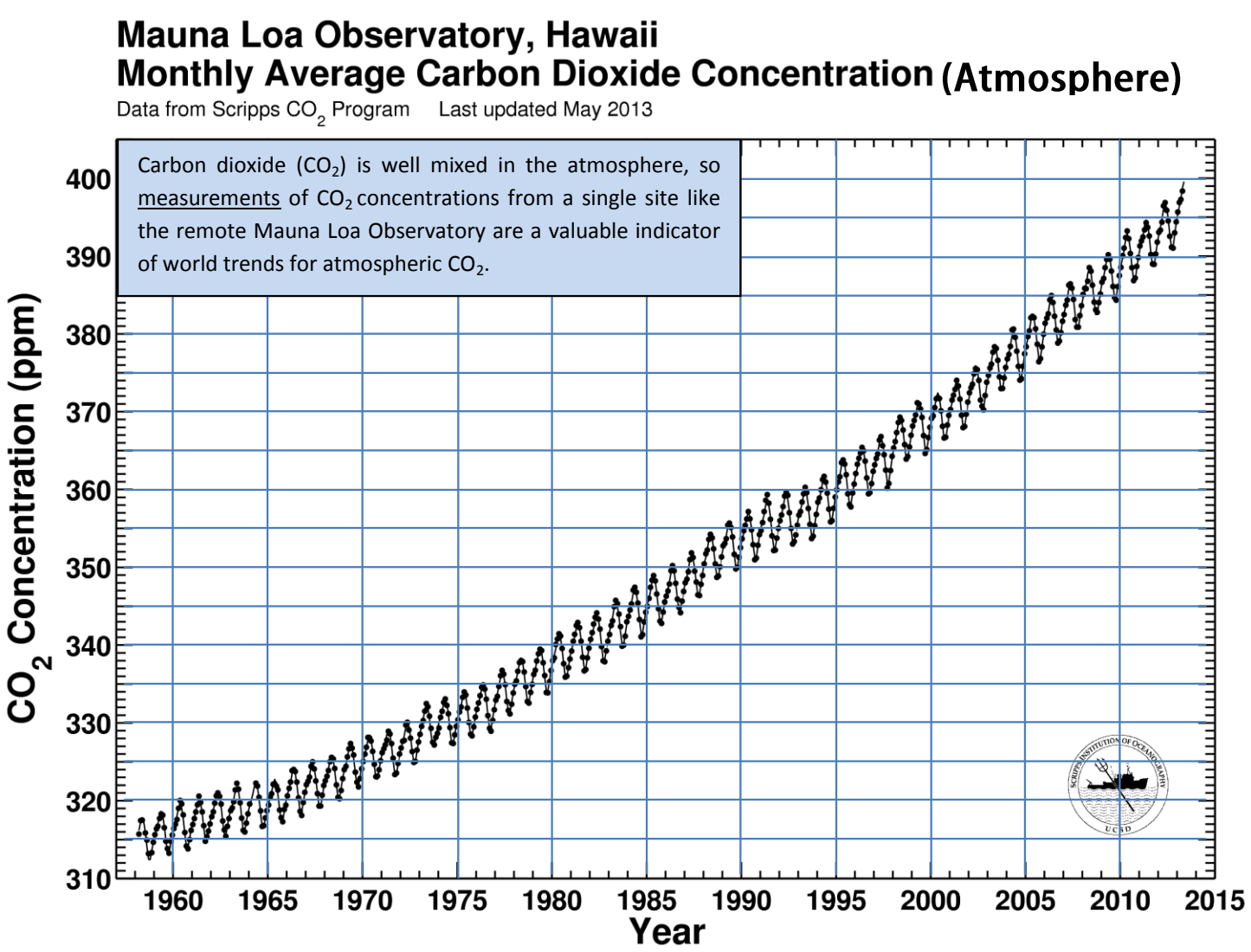


What does this mean? Distracting

Inset blocks quantitative readability of primary curve

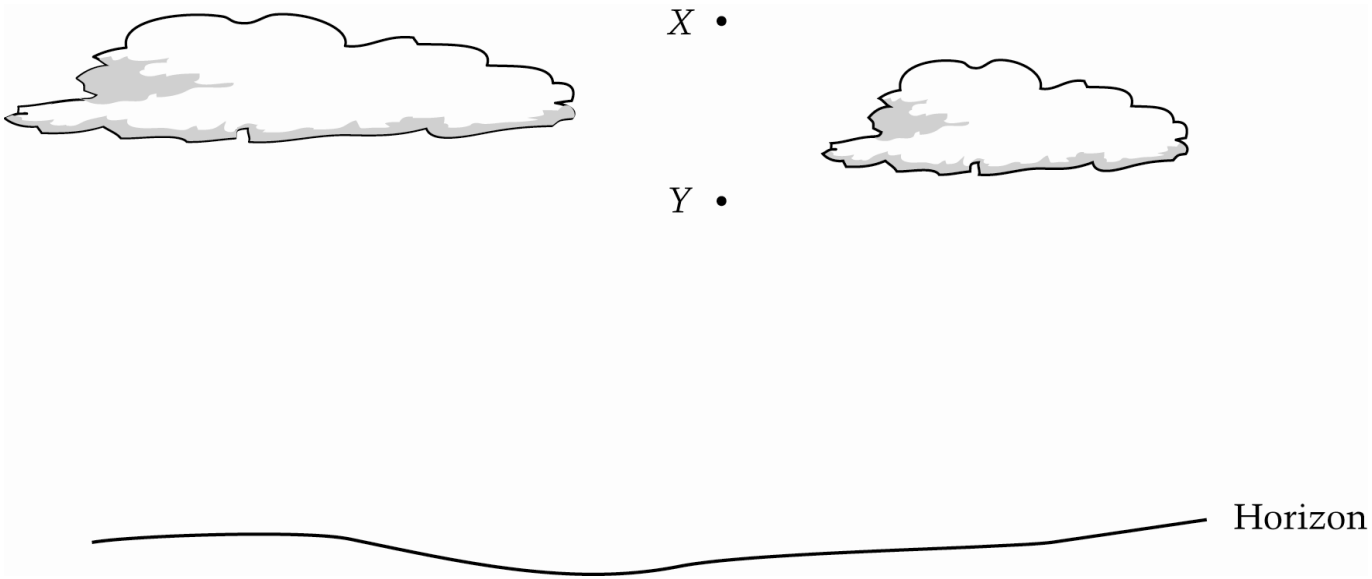
The Effect of Interviews on Graphics

Example #1 – Keeling Graph of Atmospheric CO_2 Concentration



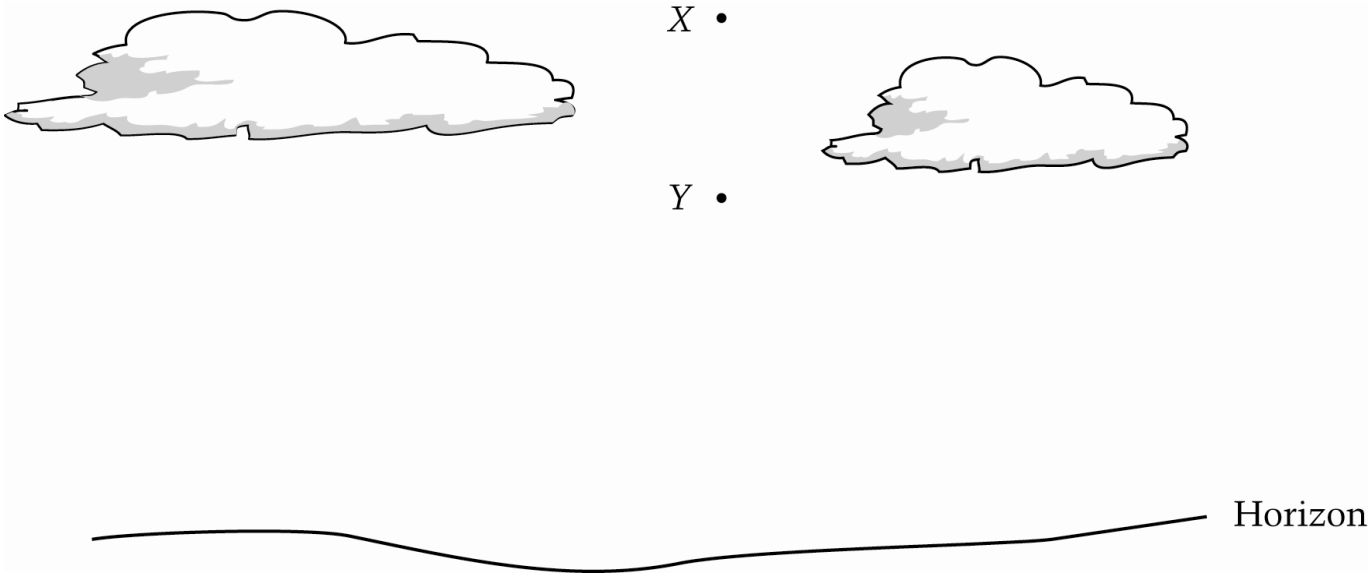
The Effect of Interviews on Graphics

Example #2 – Sun Altitude



NAEP – Released Item
Grade: 8
Year: 2009
Difficulty: Hard (33.73% Correct)
Content Area:
Earth and Space Sciences
Science Practices (2009 and on):
Using Science Principles

Question 4 refers to the diagram below.



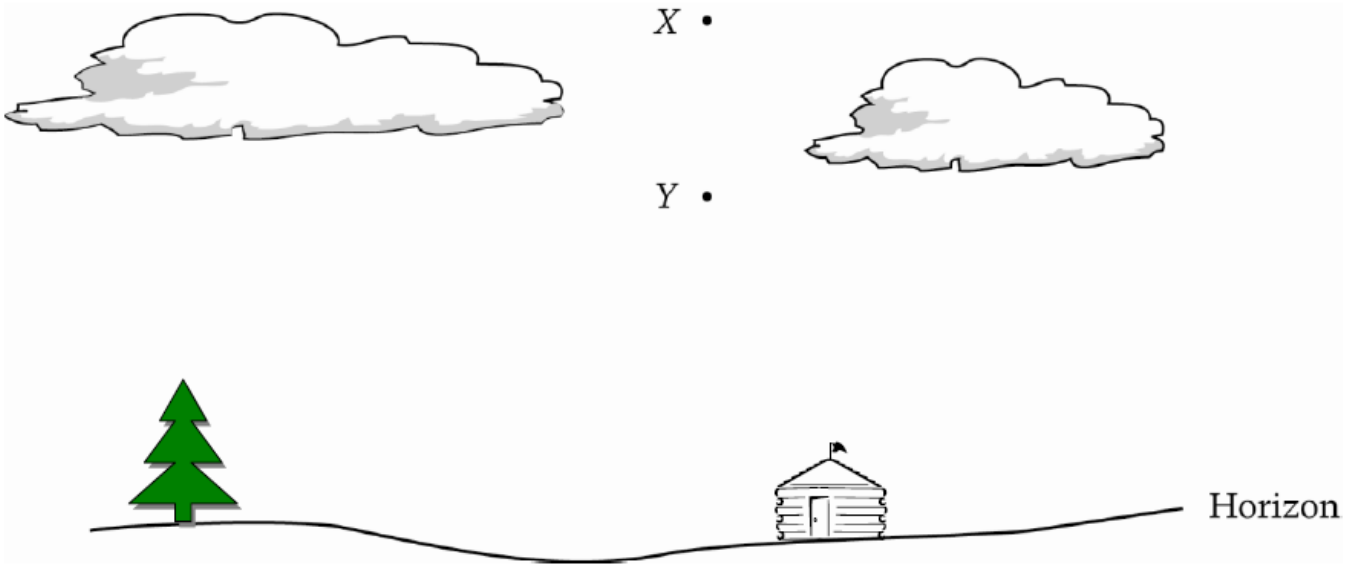
4. Point X in the diagram above shows the highest point above the horizon that the Sun reaches in the spring at noon.

When is the Sun's position most likely to be at point Y?

a. In the afternoon on a winter day
b. In the afternoon on a summer day
c. At noon on a winter day
d. At noon on a summer day

as appeared on NAEP 2009 test

Question 40 refers to the diagram below.



40. Point X in the diagram <u>ABOVE</u> shows the highest point above the horizon that the Sun reaches in the spring at noon.

When is the Sun's position most likely to be at point Y?

A. In the afternoon on a winter day

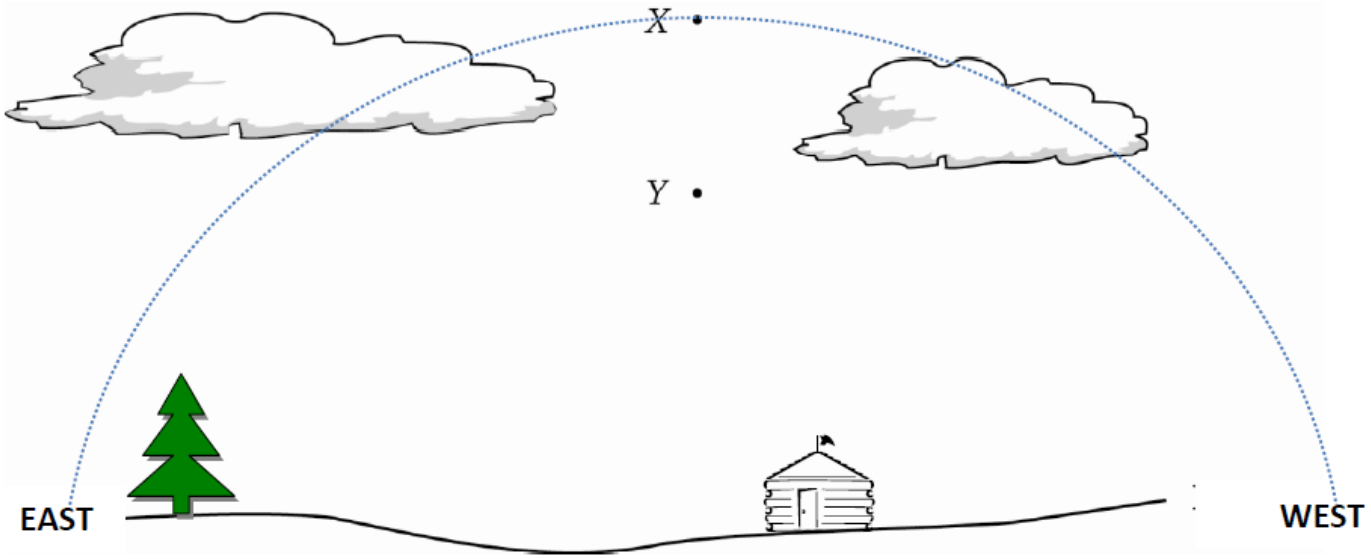
B. In the afternoon on a summer day

C. At noon on a winter day

D. At noon on a summer day

as appeared on Fa2012 POST v.6k2

Question 37 refers to the diagram below.



37. Point X in the diagram <u>ABOVE</u> shows the highest point above the horizon that the Sun reaches in the spring at noon.

When is the Sun's position most likely to be at point Y?

A. In the afternoon on a winter day

B. In the afternoon on a summer day

C. At noon on a winter day

D. At noon on a summer day

as appeared on Sp2013 PRE v.7L

Question 36 refers to the diagram below.

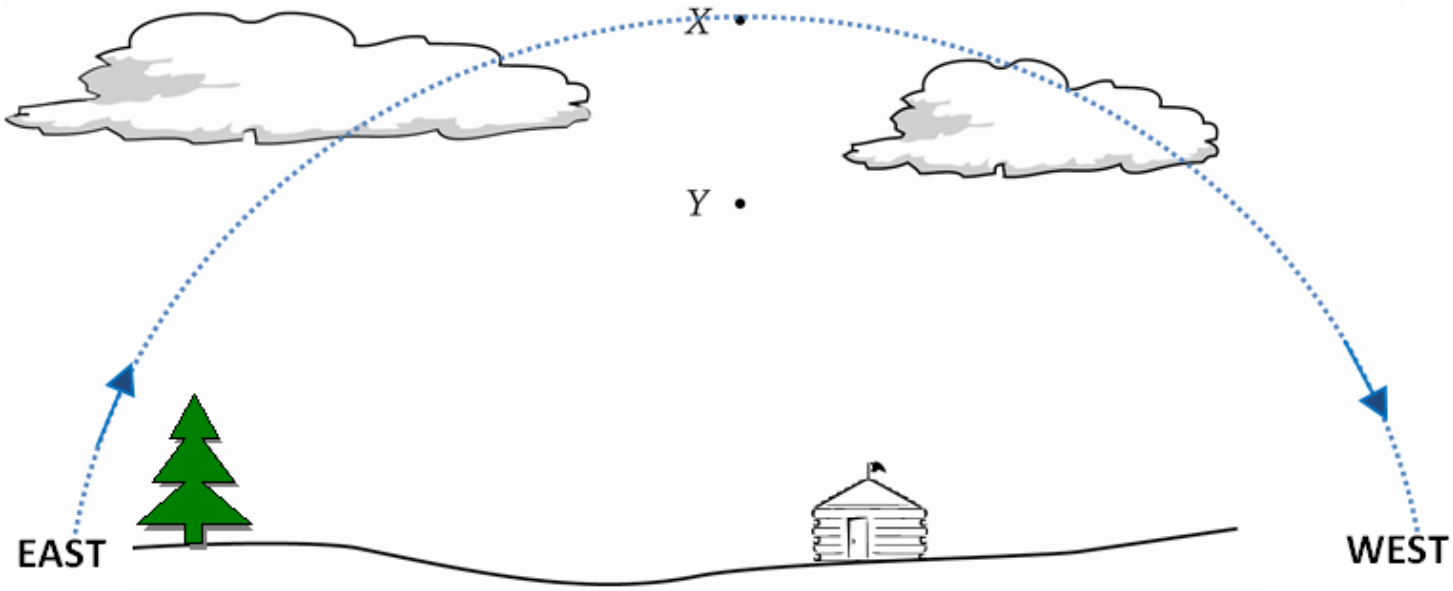


Diagram and question 36 are adapted from a released NAEP item.

36. Point X in the diagram <u>ABOVE</u> shows the highest point above the horizon that the Sun reaches in the *<u>spring at noon</u>*.

When is the Sun's position most likely to be at point Y?

A. In the afternoon on a winter day

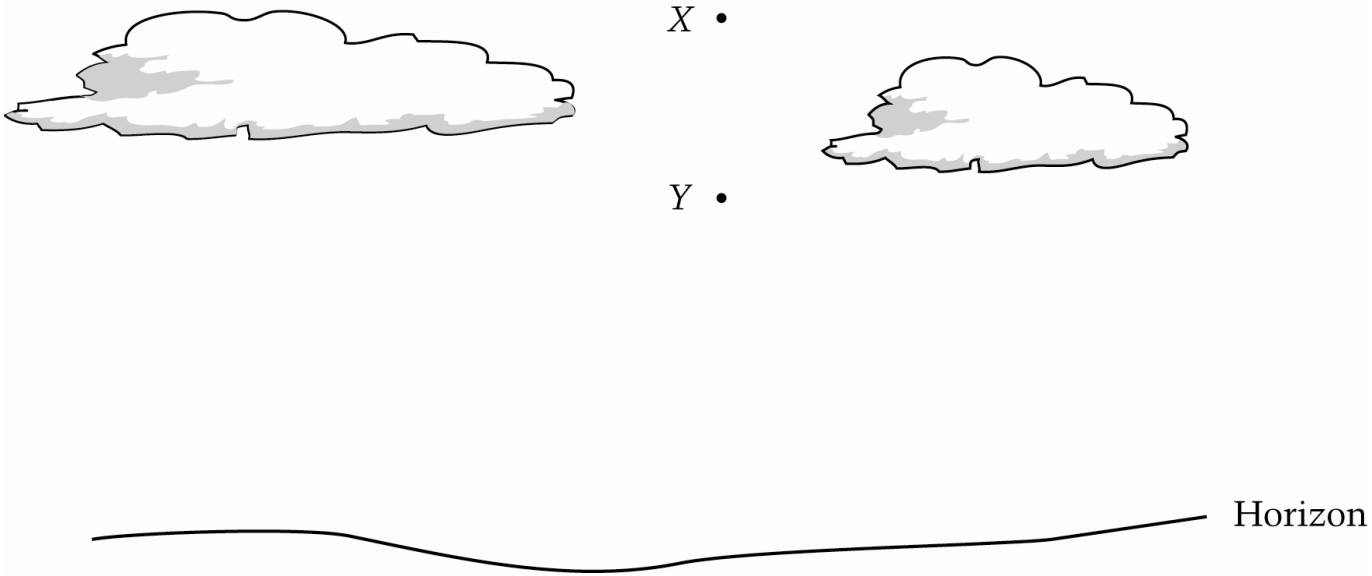
B. In the afternoon on a summer day

C. At noon on a winter day

D. At noon on a summer day

as appeared on Sp2013 POST v.8h2

Question 4 refers to the diagram below.



4. Point X in the diagram above shows the highest point above the horizon that the Sun reaches in the spring at noon.

When is the Sun's position most likely to be at point Y?

a. In the afternoon on a winter day
b. In the afternoon on a summer day
c. At noon on a winter day
d. At noon on a summer day

as appeared on NAEP 2009 test

Question 36 refers to the diagram below.

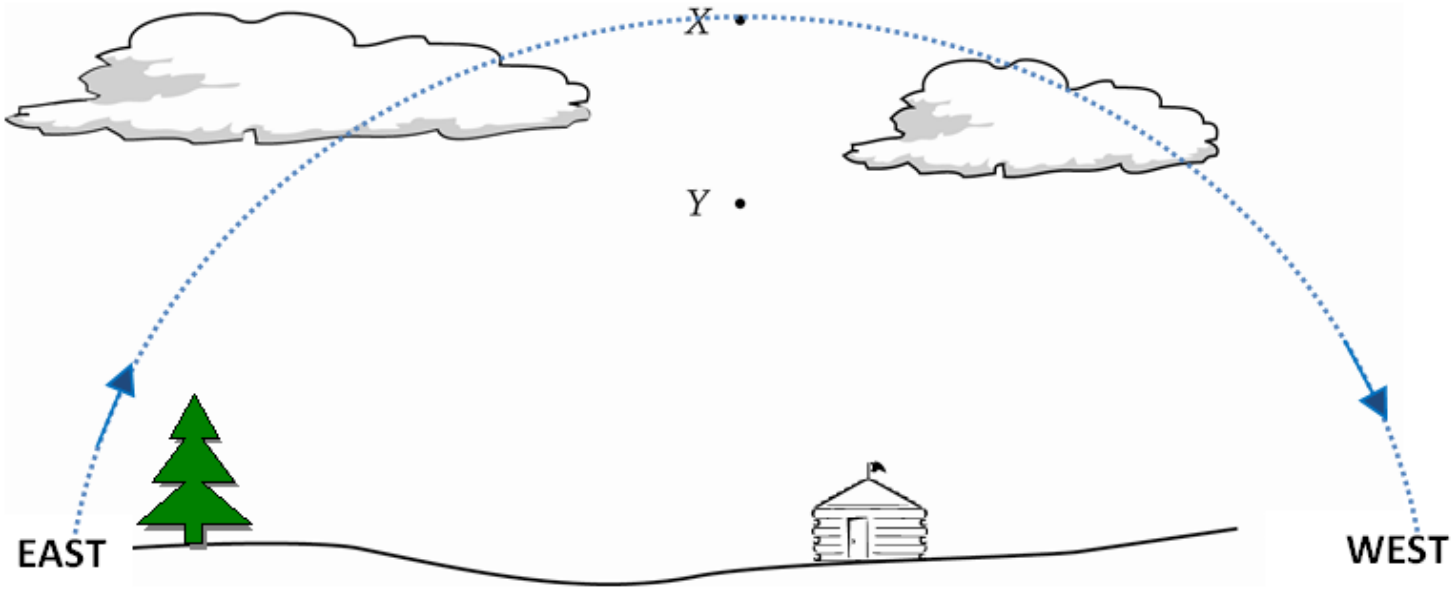


Diagram and question 36 are adapted from a released NAEP item.

36. Point X in the diagram <u>ABOVE</u> shows the highest point above the horizon that the Sun reaches in the *<u>spring at noon</u>*.

When is the Sun's position most likely to be at point Y?

A. In the afternoon on a winter day

B. In the afternoon on a summer day

C. At noon on a winter day

D. At noon on a summer day

The changes to the NAEP graphic are based on suggestions made in student interviews. Do they make the item more clear? More easy? Where is the line here? Both tend to raise % correct.

[SURVEY PREVIEW MODE] Concept Inventory for Climate Change V.9g2 Survey - Google Chrome

www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=t5LYvfPTSnHkio9jsrE1gwVTNb7FoqRpueKMJb45mKY%3d

Exit this survey

Contact cmorrow@agci.org to participate in review.

Concept Inventory for Climate Change V.9g2

1. Background and Introduction - Letter to Reviewer

Dear Climate Change Scientist, Educator, or Project Evaluator:

Thank you for your willingness to review the latest DRAFT of a DIAGNOSTIC TEST we are calling the Concept Inventory for Climate Change (CICC). Your thoughtful responses to this survey about the CICC are an important part of our development and validation process.

** WHAT is the ESTIMATED TIME TO COMPLETE this SURVEY?
Your review will take 20-60 minutes. We appreciate whatever time you can give.

** WHAT is ON THIS SURVEY?
This survey will ask you to answer a few pertinent questions about yourself, and then it will cue you to rate and comment on each item of the CICC instrument. At the end there are a few overall questions.

** WILL MY CONTRIBUTION to this REVIEW be ACKNOWLEDGED?
Absolutely yes! With your permission, we will be pleased to acknowledge your support of the instrument's development when it is ready for broader dissemination and publication.

Survey Questions for Each Item

Please rate the DIFFICULTY of Item 2 ABOVE for a college student - non-science major.

	VERY EASY	EASY	AVERAGE	DIFFICULT	VERY DIFFICULT
ITEM DIFFICULTY	○	○	○	○	○

COMMENTS:

Please rate Item 2 ABOVE for its QUALITY and RELEVANCE to climate change literacy.

	POOR	FAIR	GOOD	VERY GOOD	EXCELLENT
QUALITY	○	○	○	○	○
RELEVANCE	○	○	○	○	○

COMMENTS: Some QUALITY CRITERIA for consideration according to your expertise are: 1. relevance of content for climate change literacy; 2. level of difficulty; 3. SCIENTIFIC ACCURACY; 4. the ability to discern one, unambiguous right answer; 5. appropriateness of LANGUAGE; and/or 6. quality of answer choices as viable distractors.

Rating Overall Quality

*** Please rate the OVERALL QUALITY of this instrument in terms of the criteria listed.**

	VERY HIGH QUALITY	HIGH QUALITY	LOW QUALITY	VERY LOW QUALITY	Don't Know
Scientific Accuracy	○	○	○	○	○
Coverage of appropriate skills and knowledge related to basic literacy about climate change	○	○	○	○	○
Suitable language for college students - non-science majors	○	○	○	○	○
Appropriate level of difficulty for college students - non-science majors	○	○	○	○	○
Ability to discern one, unambiguous right answer for all items	○	○	○	○	○
Use of appropriate distractors in answer choices	○	○	○	○	○
Practicality of use (e.g. acceptable length)	○	○	○	○	○

COMMENTS - Please let us know any other thoughts you have about how to improve this instrument .

Ongoing and Future Steps

1. Final round of expert review – include project evaluators and broader field of climate scientists and educators and program officers;
2. Studying the validity of some sub-scoring options using factor analysis;
3. Correlation analysis with course grades;
4. Data comparisons with two other Georgia campuses;
5. Analysis of demographic data to see if it turns up any new insights;
6. Considering the collection of data on frozen instrument in Fall 2013 (funding dependent); and
7. Developing a simple user's manual.

Learning

Image by Peggy Monahan

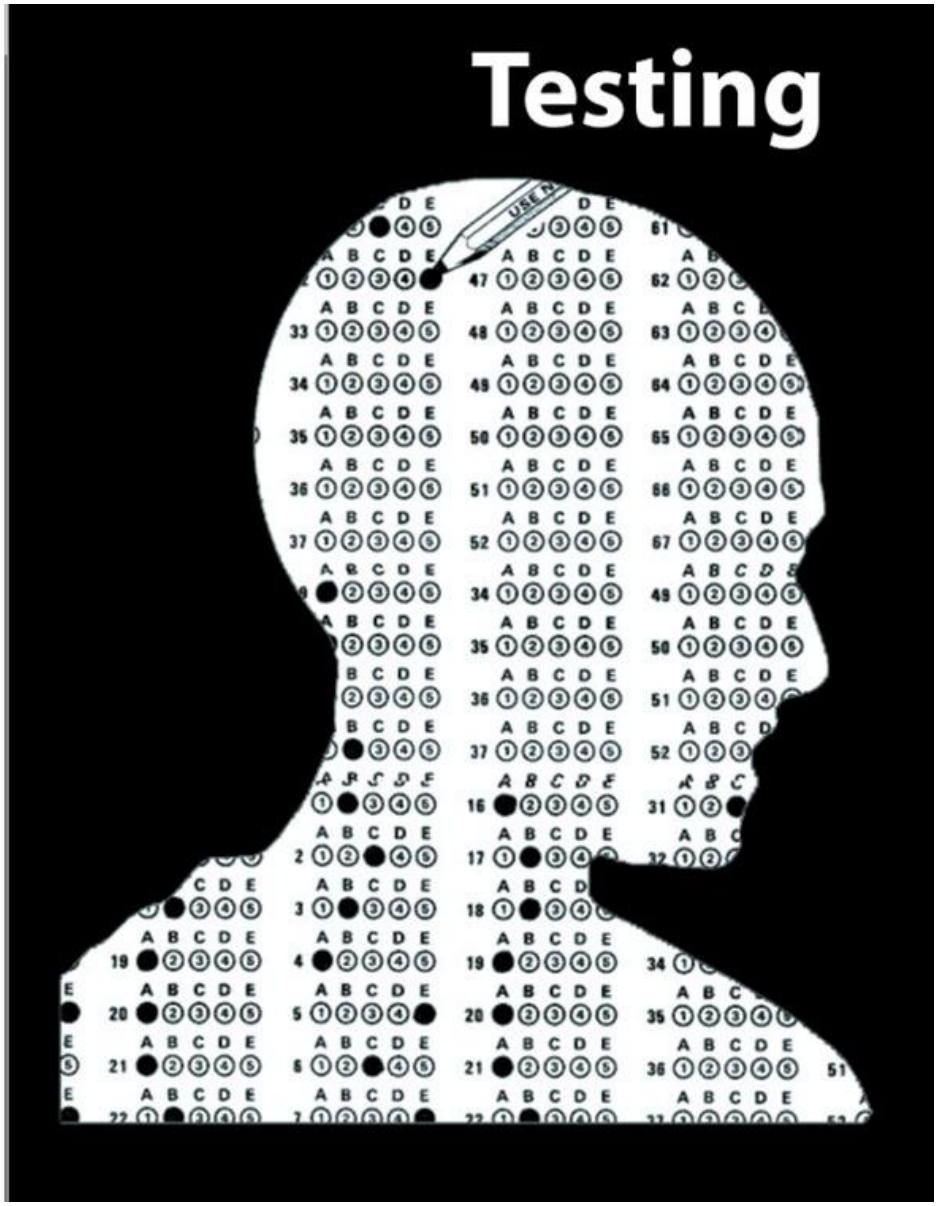


Image retrieved from http://zacksprojects.blogspot.com/2010/05/why-i-hate-standardized-test.html

Intended Use of Concept Inventory

A *multiple-choice* test cannot purport to assess deep conceptual understanding but if well developed, a multiple choice concept inventory can…

1. ***flag*** conceptual issues (PRE-instruction).
2. ***detect*** conceptual change (POST-instruction).
3. ***inform*** decisions about teaching strategies.
4. ***all of the above.**** ☺

☺ This is NOT a *best-practice* structure for an item, but it serves the intended purpose here.

Thank you for your Attention!

Your Input Please…

1. What feedback or reviews comments do you have as NASA project evaluators? https://www.surveymonkey.com/s/CICC_NASA_Evaluators PASSWD=CICC-NASA Others: PLEASE contact cmorrow@agci.org for access.

2. Offer feedback on the Survey itself. Final round of expert review with Climate Scientists and Educators in a separate collector (CLP question?)

3. Are you interested to help test the Concept Inventory? How can we disseminate V.1 to the community while preserving the value of the instrument and continuing to collect validation data at different sites?

4. What types of CICC score reports or other supplementary information/documentation would be most useful to users of this instrument? What should go into a basic user's manual?

5. Anything else? PLEASE contact cmorrow@agci.org