POLAR TREC
Learning Resources

Details

Completion Time: Less than a week

Permission: Download, Share, and Remix

Svalbard Islands and our Community

Overview
This inquiry-based activity can be done using the slides of the attached PowerPoint presentation, or using a smart board. The slides describe the phases of the Inquiry Based Learning, step by step. The reference model is the "BSCS 5E model" (Bybee W. et al., 2006).

Objectives
Students will learn about global warming through inquiry-based learning and experimentation.

Lesson Preparation
Prepare materials for the hands-on experiment. Follow instructions and photos starting on slide 11.

Procedure
The Inquiry Based "Pathway"

Slide 1: Title and subtitle
I've chosen a significant title, which gives an idea about the relationship existing between the far North (Svalbard isles in this case) and our Mediterranean Regions. Why is it important to study what happens in the Polar Regions? Leading the proposed activity, the student not living in the Polar Regions can understand that the whole Earth is involved in global warming and most parts of Earth's future depend on what could happen at these latitudes.

Slides 2-3: Getting Started
The students have to look at the first two pictures (slide 2 and 3), in order to hunt for differences and similarities between them. If you have a smart board, the pictures can be visualized together, side by side. The students can take part in brainstorming, speaking to their classmates, or writing their own opinion on the student notebook. The pictures are shown without revealing where they come from. It is important that the students are

Materials

- Aluminium or plastic rectangular basin (see photos in PowerPoint presentation)
- Tap water
- Colored gravel (as alternative, natural gravel)
- Freezer
- Hammer
- Cutter
- Thermometer
- Heat source (e.g. lamp, hairdryer etc.)
- Multimedia resource: Google Earth
- Interactive white board (smart board)
- Computer room
- PowerPoint presentation (attached)

elicited in the comparison.

Slide 4: Warming up
The teacher collects opinions from the students. When the brainstorming has finished, it's possible to resume the proposals coming from the students. If you have the smart board, you can write on it. At the end, the teacher confirms evidence.

Slide 5: Initial assignment
The teacher reveals the glaciers' locations (Svalbard and Italy) and the students are invited to find their right position on Earth, using Google Earth. If necessary, the teacher can help them using the smart board, connecting with Google Earth, and showing it to the class. Moreover, the students can lead web research about:
• Different kinds of glaciers on Earth (alpine glaciers and inlands in particular)
• Presence of glaciers vs. altitude at different latitudes
• Wet and cold glaciers
• Different parts of a glacier, their names and their role in establishing a glacier. Alternatively, the teacher can support students with documents containing all basic information.

Slide 6: First outcome
Reflection and research lead students to first outcome. They find general features and behaviors. This step is necessary to carry on further phases of inquiring.

Slide 7: Further input
At this point, the students have to look at the picture with a valley and a lake in foreground. What is this picture concerned with? What are the links between this location and the previous glaciers?

Slide 8: Nothing is what it looks like…
The valley in the picture is artificially filled with hand-drawn ice. If you have a smart board you can use the "pen" button for drawing ice in the valley (white color, for ice – gray, for crevasses). Looking at this image, the students should argue that the valley and the lake have glacial origins.

Slide 9: Further outcome
Students and teacher collect further outcome: the valley and lake have glacial origin. In fact, the shape of the valley is typically a U. Moreover, the lake is very deep (more than 400 m).

Slide 10: Complete information, test hypothesis
Students have to do extra research about the Lake Como and its origin. In particular, they have to explain why the ancient glacier melted. At this moment, the students start with their working hypothesis and they will validate by hands-on experimenting.

Slides 11-12: Exploring by Hands-on experiment
Here we have the procedure for the experiment. The students can work in small groups. If your freezer is too small, only one glacier will be prepared and the students will do their own observations basing on the behavior of the unique sample. However, it would be preferable if you could prepare at least a glacier for each group plus an extra glacier as control sample. The groups can use extra tools, like lamps, or hairdressers, or light sources (e.g. working close to a window). Every group will record the temperature near the surface of ice with a thermometer.

Slide 13: Observing ice melt
Ice melts gradually. The gravel is transported by fusion water, producing "fluvioglacial deposits". Pouring water on ice, the students can observe that it sinks down because of its density that is higher than the density of ice. The students will observe probably different features in the deposits, like "glacial lakes" "moraines" and "rivers". Each group will collect data about these elements. They can make photos or record a movie during the experiment.

Slide 14: Collecting data
During the experiment, the students collect data about their "glacier" and compare it with the control sample. They measure temperature every ten minutes, positioning the thermometer at 3 cm from the ice surface. At the end, they probably observe that temperature has risen more in their own glacier than in the control sample. If you have a smart board, it is possible to compare the results of all the groups and discuss the outcome of all groups.

Slide 15: Elaborating data
At the end of the experiment, the students have to elaborate their data and provide generalizations. In the slide there are some questions the students have to answer. They have to research information about the global situation, in order to improve their evidence.

Slides 16-17: Explaining causes of retreat
The students have now to focus on the graph showing global increase of both temperature and CO2 air concentration from 1880 to the present. The graphs are strictly related to each other, if the students already know the greenhouse effect, they can get to the final outcome: the increase of temperature causing retreat of ice cover on Earth is due to the increase of greenhouse gases, like CO2. Otherwise, if the students don't know this effect, this evidence can be an opportunity to begin a further inquiry-based activity, which can dig deeper into this issue.

Slide 18: Evaluating activity
The final activity is the evaluation. The students could perform a final test, but it is preferable to assess an inquiry-based activity performing an "authentic assessment", like a presentation or a poster showing the final outcomes to classmates and teacher. Actually, this is the way to assess the work of a true researcher.

Learning Resources

Extension
n/a

Resources
Resources listed in PowerPoint presentation.

Assessment
Slide 18 provides assessment suggestions.

Credits
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Learning Resources

National Science Education Standards (NSES)

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard B: Physical Science
a. Properties and changes of properties in matter
b. Motions and forces

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

SVALBARD ISLANDS and our community

An example of Inquiry Based Learning about Global Warming effects

PolarTREC Online Course for Educators Summer2012

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Look at this landscape
engage
Teaching info: A Svalbard icefield


Compare this landscape
with the previous one
engage
Teaching info: A glacier from Italy -
Marmolada (Dolomites)

Preliminary brainstorming
(the probable answers of students are written in red)

engage

The landscapes look similar because of:

- glacial environment
- it is possible to recognize the basic elements of a glacier

The landscapes look different because of:

- rock colors (dark rocks in the first picture)
- sky color (more light intensity in the second picture)
- glacier slope is low in the first glacier
- In the background of the first landscape we can look at sea
- the length of the shadow demonstrates that the sun is higher in the sky in the second picture →probably the second glacier is at lower latitudes

engage

Preliminary task:

1- Using Google Earth application, look for the locations of both glaciers.

2- Using the internet or other information source, look for names and meaning of different glacier parts.

3 - Why are the glaciers so important as fresh water reservoir?

engage

First outcome:

- ✓ continental glaciers establish at every latitude depending on altitude
- ✓ all continental glaciers present similar features
- ✓ a glacier increase in ice volume if the snow accumulation exceeds ablation
- ✓ If the ablations exceeds accumulation the glacier retreats


What about this landscape?
engage
Teacher info: Lake Como, in the North of Italy


And now?
engage

engage

Further outcome

Actually, we can argue:

- ✓ in the past, the Lake Como and its valley were occupied by a glacier
- ✓ Ice melting determined the establishment of an lake, which is strengthen along the valley
- ✓ The profile of the valley is typically U-shaped

engage

Further tasks:

1- Why did the glaciers in the North of Italy retreat?
When did it happen in the past?

2- More in general, what factors determine ice retreating?

Shall we test the following hypothesis:

The ice retreat is due to increase of temperature.

Hands-on experiment

Building up a mini-glacier

explore

Procedure (see photos in next slides)

24 hours before experiment:

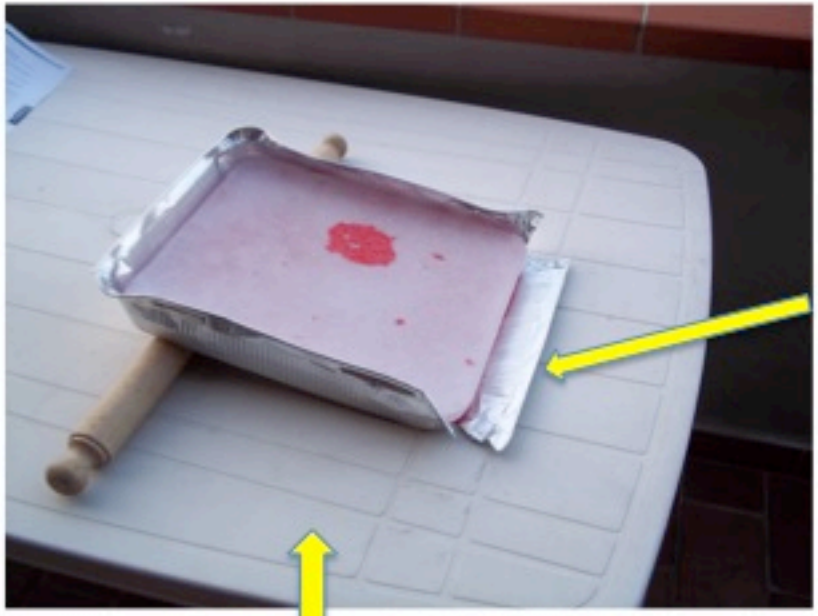
- fill half a basin with water and colored gravel
- put the basin in the freezer

Experiment:

- get the basin out from the freezer and put it on the table. Keep the basin tilted with a wedge
- cut the short border of the basin with a cutter
- wait for melting and observe what happens
- you can be supported by heat source like a lamp

MODELLING A MINI- GLACIER

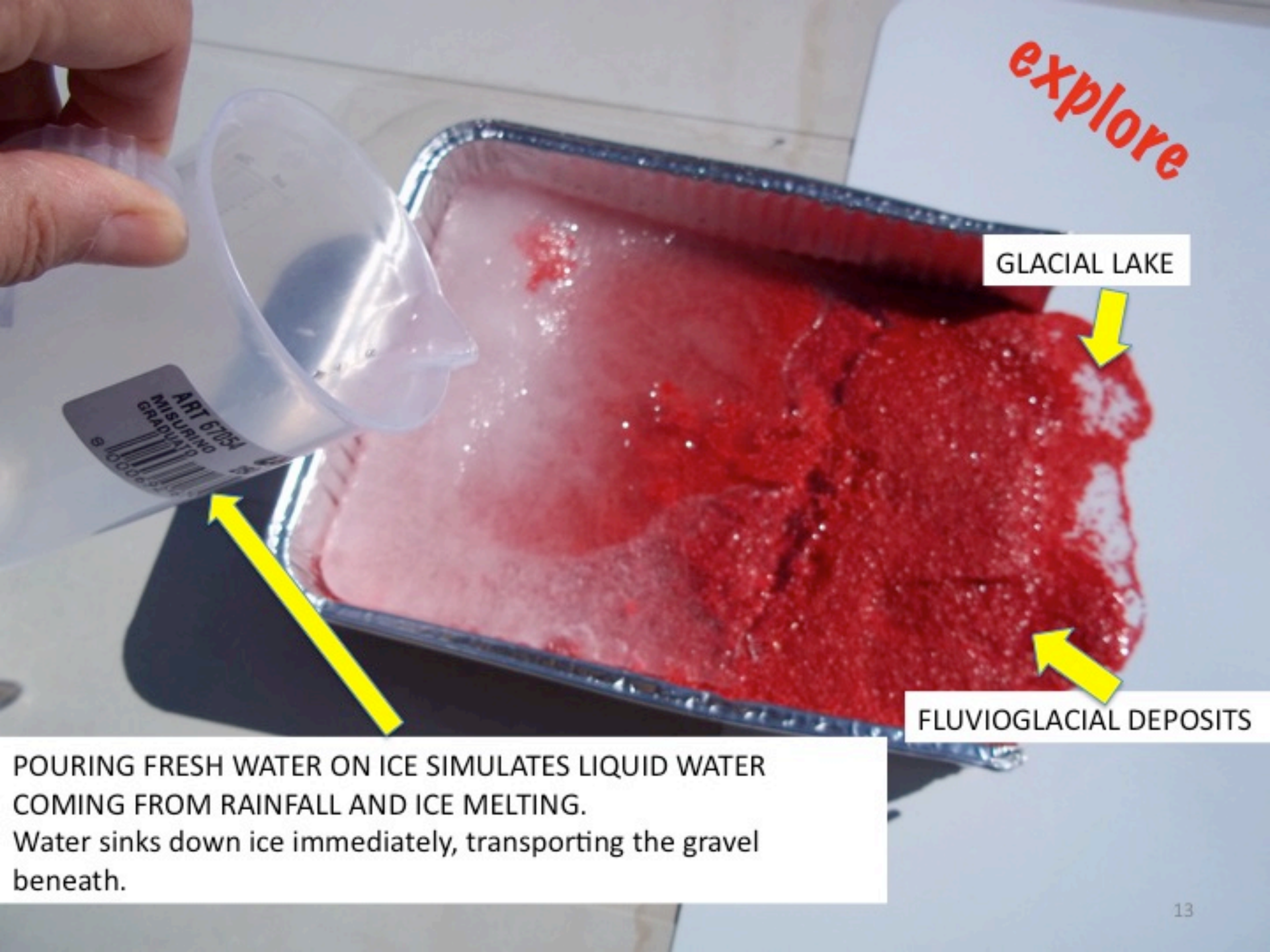
explore



cut the short border

freeze water mixed with colored gravel in a basin
(the gravel simulates the sediments
transported by the glacier)

make cracks on ice with a hammer
(the cracks simulate crevasses)



POURING FRESH WATER ON ICE SIMULATES LIQUID WATER COMING FROM RAINFALL AND ICE MELTING.
Water sinks down ice immediately, transporting the gravel beneath.

Collecting data about ice melting.

explore

	temperature*				
	at the beginning T_0	after 10 min T_1	20 min T_2	30 min T_3	40 min T_4
control sample					
group sample (heat source is....)					

* the temperature is taken down positioning the thermometer at 3 cm from the ice surface

elaborate

Elaborate your data:

1- Plot in a graph (time vs. temperature) the data of your table. What can you notice about?

2- Why does resist the control sample the fusion longer than the other samples?

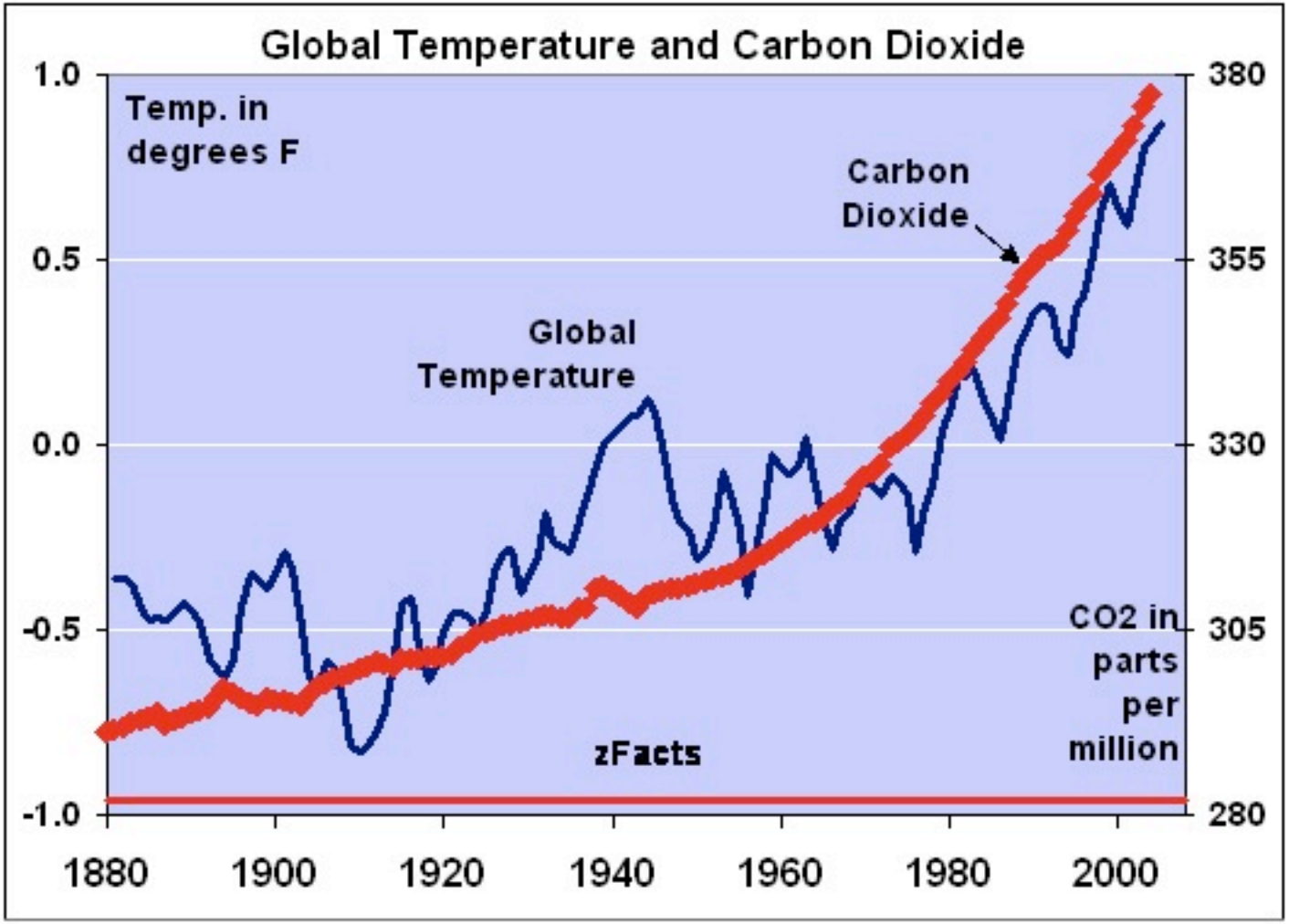
3 - Can you argue general outcomes? Improve your initial hypothesis.

4- Do a research in the Internet about glaciers retreat around the world. What about Svalbard glaciers? What about the Alpine ones?

Video suggested: http://www.youtube.com/watch?v=b4QjyrGkaUg...

Look at the graph* showing CO_2 abundance vs. mean temperature during the past 130 years

explain



*from www.zfacts.com

explain

1-What can you argue?
Are CO_2 rising and temperature related each other?

2- What is your knowledge about the greenhouse effect?

Evaluate your activity:

1- Present your results in a power point presentation using at least 10 slides.

as alternative

2- Present your results in a poster

References

- Bybee W. et al., 2006 – The BSCS 5E Instructional model, Origins, Effectiveness, and applications. – BSCS Coorado Springs.
- http://www.nap.edu/openbook.php?isbn=0309064767inquiry book
- http://www.agiweb.org/earthcomm/earth comm
- IPCC http://www.ipcc.ch/
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- spes http://www.mna.it/SPES/SPEs.html
- http://climate.nasa.gov/keyIndicators/