

POWERING AGAINST BLACKOUTS (PART 2) (LEVEL 3)

Description:	In this project, learners will explore the environmental and sustainability tensions around the generation of electricity and craft recommendations for local officers who are trying to address the issue of blackouts.
Leading question:	What can you do to minimize blackouts?
Total time required:	~ 5.5 hours over 5 days
Supplies required:	paper, pencils, post-it notes (if available)
Subjects:	Science, Environmental Studies, Literacy
Supervision	Medium supervision
Learning outcomes:	<p>In terms of language, learners will be able to:</p> <ol style="list-style-type: none"> 1. Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text. 2. Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent. 3. Write informative/explanatory texts to examine a topic and convey ideas and information clearly. <p>In terms of science/environmental studies, learners will be able to:</p> <ol style="list-style-type: none"> 1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
Previous learning required	We recommend learners work on “Powering Against Blackouts-Part 1” before engaging with this project.

DAY 1 - Today you will be learning to understand the scope of the problem of blackouts around the world

Suggested Duration	Activity and Description
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<p>5 minutes</p>	<ol style="list-style-type: none"> 1. If learners have worked on “Powering Against Blackouts-Part 1,” begin by recalling some important concepts of electricity, current, circuit, and power grid. Ask learners to share one thing that they learned from working on that project. 2. Introduce the goal of the new project: understand how blackouts affect their communities and write a newspaper article to share to craft recommendations to solve the problem. 3. Ask students to read or look closely at some of these resources.
<p>20 minutes</p>	<p><i>We suggest you choose ANY 2 of them to focus on for Day 1. Since students will be asked to write a newspaper article, make sure you include at least one of these in the list of resources. When contextualizing the project, you can include an article from a local newspaper that addresses the issue of blackouts too.</i></p> <p><i>If printing is not available, we suggest recording a voice note where the chosen articles are read to the students.</i></p> <p>Resource #1 (newspaper article):</p> <p>Weak Power Grids in Africa Stunt Economies and Fire Up Tempers (Excerpt and adaptation from https://www.nytimes.com/2015/07/03/world/africa/weak-power-grids-in-africa-stunt-economies-and-fire-up-tempers.html)</p> <p><i>July 2, 2015</i></p> <p><i>JOHANNESBURG — “It’s like death” Buhle Ngwenya, 45, said, referring to the blackouts imposed to prevent a collapse of the national electricity grid.</i></p> <p><i>With winter in South Africa, the worst blackouts in years are plunging residents into darkness in poor townships and wealthy suburbs alike. The cutoffs have affected the economy, Africa’s second biggest, and are expected to continue for another two to three years.</i></p> <p><i>Despite a decade of economic expansion, sub-Saharan Africa is still far behind in its ability to generate something fundamental to its future, electricity.</i></p> <p><i>Nigeria’s electrical grid generates so little power that the country mostly runs on private generators. So when a fuel shortage struck this spring, a national crisis quickly followed, disrupting cell phone service, temporarily closing bank branches and grounding aeroplanes.</i></p> <p><i>“It’s not only a symbol of failure when the lights go off,” said Anton Eberhard, an energy expert and a professor at the University of Cape Town. “It’s experienced directly by people. If you’re about to cook or if your child is studying for an exam the next day and your lights go off, people feel this very directly. There is a very concrete and dramatic expression of failure.”</i></p>

	<p><i>South Africa's recent history of electrification is more complicated, and it has been the subject of fierce debate as the current blackout crisis has dragged on for several months. In the last years of apartheid, before a democratic government was elected in 1994, electricity reached only a third of South African households, few of them black. 85 per cent of households now have electricity, a remarkable accomplishment by any standard.</i></p> <p><i>President Jacob Zuma has forcefully rejected any blame for the energy crisis. The strain on the grid, he said, resulted from the burden of bringing light to millions of black households that lacked power under white-minority rule.</i></p> <p><i>But energy experts say that these households, many of them low-income, consume little electricity. Instead, they said, the shortages result from frequent breakdowns at ageing plants and, most critically, the delayed construction of two new facilities.</i></p> <p><i>South Africa, which has the continent's only nuclear power plant, has around half of sub-Saharan Africa's power-generating capacity. Still, the power cuts contributed to a recent drop in economic growth and a spike in unemployment to 26.4 per cent, the worst level in a dozen years.</i></p> <p><i>The blackouts have affected everyone, including giant gold mining companies, small businesses, and individuals.</i></p> <p><i>South Africans are buying up generators, rechargeable lights and gas burners. They plan their days and evenings around blackouts scheduled by the utility. Dominating South Africa's list of popular app downloads are ones that alert smartphone users to the impending start of a cutoff in their neighbourhood or the risk of one as load shedding across the nation increases.</i></p> <p>Resource #2 (Newspaper article): 2nd Day of Power Failures Cripples Wide Swath of India (Excerpt from: https://www.nytimes.com/2012/08/01/world/asia/power-outages-hit-600-million-in-india.html)</p> <p><i>July 31, 2012</i></p> <p><i>NEW DELHI — On Tuesday, India suffered the largest electrical blackout in history, affecting an area encompassing about 670 million people, or roughly 10 percent of the world's population. Three of the country's interconnected northern power grids collapsed for several hours.</i></p> <p><i>Theories for the extraordinarily extensive blackout across much of northern India included excessive demands placed on the grid from certain regions, due in part to low monsoon rains that forced farmers to pump more water to their fields, and the less plausible possibility that large solar flares had set off a failure.</i></p>
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For millions of ordinary people, Tuesday brought frustration and anger; for some, there was fear. As nighttime arrived, Kirti Shrivastava, 49, a housewife in the eastern city of Patna, said power had not been restored in her neighbourhood. “There is no water, no idea when electricity will return,” she said. “We are really tense. Even the shops have now closed. Now we hope it is not an invitation to the criminals!”

Sushil Kumar Shinde, the power minister, who spoke to reporters in the afternoon, did not specify what had caused the grid breakdown but blamed several northern states for consuming too much power from the national system.

Surendra Rao, formerly India’s top electricity regulator, said the national grid had a sophisticated system of circuit breakers that should have prevented such a blackout. But he attributed this week’s problems to the bureaucrats who control the system, saying that civil servants are beholden to elected state leaders who demand that more power be diverted to their regions — even if doing so threatens the stability of the national grid.

India’s power sector has long been considered a potentially crippling hindrance to the country’s economic prospects. Part of the problem is access; more than 300 million people in India still have no electricity.

But India’s power generation capacity also has not kept pace with growth. In cases when demand outstrips the power supply, the system of circuit breakers must be activated, often manually, to reduce some of the load in what are known as rolling blackouts. But if workers cannot trip those breakers fast enough, a failure could cascade into a much larger blackout.

Some experts attributed excessive demand in part to the lower levels of monsoon rains falling in India this year, which have reduced the capacity of hydroelectric power and forced many farmers to turn to electric pumps to draw water from underground.

Resource #3 (Photograph of a woman who ran her restaurant by candlelight during a blackout. Credit: Nic Bothma/European Pressphoto Agency):



Resource #4 (map of power grids around the world from <https://engineering.fb.com/2019/01/25/connectivity/electrical-grid-mapping/>):

20 minutes



5. Get the learners to write down three details that stand out for them from each resource, two reactions that they have, and one question you want to ask.

This is an example of what students are asked to do:

3 details that stand out

-In the map, I see that India has many power grids.
-Low Monsoons can cause blackouts
-Blackouts bring frustration and anger

2 Reactions

(i) I'm surprised by how much is affected by blackouts
(ii) The map has sparked my curiosity about the differences between countries

1 Question

I wonder if the situation in my community is similar to the one described in the article about India?

6. Have them share what they wrote out loud.

7. Ask the learners: Besides the details that stood out for you in general about the resources, what are five adjectives or details (if it's an image) that the authors use to give you a vivid picture of what some people are experiencing because of weak power grids?

Below is an example of what the students are asked to do:

<p>15 minutes</p>	<p>Words:</p> <ul style="list-style-type: none"> -darkened -crippling -failure -everyone <p>Details:</p> <p>There is contrast between black and light in the picture.</p> <p>8. To understand the scope of the problem of blackouts, and also understand some of the strategies that authors use to back their claims, guide learners to find at least 3 numbers (data points) in these resources.</p> <p>For example, below are some questions you can ask:</p> <ul style="list-style-type: none"> ● How many people have been affected by recent blackouts in India, Nigeria, South Africa, Venezuela and/or the USA? ● How many homes and businesses have had their power interrupted in the last year? ● How much does demand for electricity outpaces supply in India? ● What are the economic costs of blackouts in South Africa? <p>9. After going through these steps, guide the learners to identify what the author’s main points are about how blackouts impact communities. Learners can draw a map showing 2-3 different sectors/areas of life affected by the blackouts.</p> <p>Introduction to the Final Outcome of the Project:</p> <p>As we have seen, blackouts affect people and the environment in different ways. What are the criteria for a good solution to this problem? In this project, we will come up with a set of recommendations to solve this problem that are cost-effective, sustainable, just, and scientifically sound.</p> <p>To get to this point, we will explore the following questions:</p> <ul style="list-style-type: none"> ● How would an electrical grid look like in your community and why? (Based on Powering Against Blackouts Part 1) ● What are the consequences of blackouts in your own community? ● What are the environmental costs of energy production? <p>After this exploration, you will have to give advice to local officers and community leaders to help them make good decisions about generating energy in a sustainable way.</p>
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DAY 2 - Today you will be *working on gaining a deeper understanding of the problem in the community*

Suggested Duration	Activity and Description				
15 minutes	<p>1. Ask learners to imagine that they have been hired by their local newspaper to create a new article on power outages in their community. The article will spotlight the experience of someone in the community and how they have been affected by blackouts.</p> <p><i>Students can choose to spotlight a family member, a neighbour or a close friend who has been affected by the blackouts. If they can't find anyone in their community, they can ask people about the potential consequences that a power outage would have for them.</i></p> <p>Before learners start interviewing, ask them to consider the following questions.</p> <table border="1" data-bbox="566 926 1419 1276"> <tbody> <tr> <td data-bbox="566 926 992 1094">Whom would you profile and why?</td> <td data-bbox="992 926 1419 1094">What things would you try to collect evidence of?</td> </tr> <tr> <td data-bbox="566 1094 992 1276">What questions would you ask to know more about this person's experience?</td> <td data-bbox="992 1094 1419 1276">What questions would you ask to collect data to show the impact or scope of the problem?</td> </tr> </tbody> </table> <p>2. Get the learners to develop their own "interview protocol." On a piece of paper, they will write down their set of 10 or so questions that are specific to their community.</p> <p>Here are a few examples of questions that can get them started (you can share these examples with the students):</p> <ul style="list-style-type: none"> ● How have the power outages affected you? ● What do you do when there's a power outage? ● What would you want people in other communities across the world to understand about the impact of the energy cuts where you live? ● How well do you think local officials handle this problem? ● What are some potential solutions to this problem? 	Whom would you profile and why?	What things would you try to collect evidence of?	What questions would you ask to know more about this person's experience?	What questions would you ask to collect data to show the impact or scope of the problem?
Whom would you profile and why?	What things would you try to collect evidence of?				
What questions would you ask to know more about this person's experience?	What questions would you ask to collect data to show the impact or scope of the problem?				

15 minutes	<p>3. Reviewing and Adjusting the Questions. Get the learners to reflect on their questions by thinking about the following:</p> <ul style="list-style-type: none"> ● Are the questions clear enough for anyone to understand them? ● Are there enough questions for a 10-15 minute conversation? Are there too many? Do you need to add or remove some questions? ● To what extent are the questions allowing you to understand who the person is? ● To what extent are the questions allowing you to understand their experience with blackouts? ● To what extent are the questions allowing you to begin to think about solutions for this topic? <p>4. Ask learners to rewrite their interview questions based on their reflection.</p>
30 minutes	<p>5. Interview.</p> <p>Ask students to interview one person in their community. The interview should take students around 15 minutes. Remind students to ask permission if they plan to share the person’s name publicly or with the class.</p> <p>Learners can also do this virtually or remotely if locked down; they can call, text, mail or email respondents to interview them.</p> <p><i>Make sure to tell students that it is important that they write down the answers and collect as much evidence as they can because they are going to use them for writing the article on Day 4.</i></p>

DAY 3 - Today you will write a Rough Draft of a Newspaper Article

Suggested Duration	Activity and Description
10 minutes	<p>1. Learners will begin by writing a thank you note for the person(s) they interviewed. They should include in the note their major takeaways from the interview. <i>This will help learners reflect on what they learned from the interviews.</i></p>


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<https://forms.gle/pVXs3vQEufuzSShs7> 8

<p>10 minutes</p> <p>15 minutes</p> <p>40 minutes</p>	<p>For the writing process, learners should have available their interview notes. Remind the learners that they will be writing a newspaper article to be read by the people in their communities in which they explain, through the experience of the person that they interviewed, how blackouts are affecting their community.</p> <ol style="list-style-type: none"> 2. Learners will brainstorm for 10 minutes and note ideas. At this point, the ideas do not have to be in complete sentences. (Ex: "A big problem," "People find solutions," "It affects businesses," "candles are dangerous.") 3. Once done, get the learners to group their ideas. They should try to find three general categories <i>e.g.: "A big problem," "candles are dangerous," and "it affects businesses" can be grouped under the heading of "Negative consequences."</i> 4. Invite students to organize an outline of the main points from their brainstorming. Learners will select the data, quotes, and details that will back their main points (the three general categories). They should try to use data from their interviews, but they can also draw on the material they engaged with on other days of the project. 5. Before learners begin their writing process, discuss the <u>Assessment Criteria</u> for their writing. Make sure that they fully understand each of the aspects that are expected from their writing. <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p style="text-align: center;">Assessment criteria for Newspaper Article</p> <ul style="list-style-type: none"> <input type="checkbox"/> Formatting <ul style="list-style-type: none"> ○ Include formatting (e.g., headings), illustrations, and multimedia when useful or possible to aid comprehension. ○ Between 200 and 400 words <input type="checkbox"/> Explanation of ideas and information: <ul style="list-style-type: none"> ○ Uses details, quotations, and examples to support descriptions ○ Uses facts to support claims and arguments. ○ Use precise language and domain-specific vocabulary to inform about or explain the topic. <input type="checkbox"/> Organization and structure: <ul style="list-style-type: none"> ○ States main idea and moves from one idea to the next in a logical order, emphasizing main points in a focused, coherent manner. ○ Has an effective introduction and conclusion. ○ Uses connectors to emphasize ("Especially," "in particular"), contrast ("but," "however"), express cause-effect relations ("therefore," "as a result"), and illustrate ideas ("for example"). </div>
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	Give learners enough time to write down their articles.
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DAY 4 - Today you will have a look at electricity and the environment

Suggested Duration	Activity and Description
20 minutes	<p>Theme: Electricity and the Environment</p> <ol style="list-style-type: none"> 1. Introduce the learners to the idea of sustainability and our current environmental concerns. Brainstorm with the learners the meaning of “sustaining.” <p>Ask: What are some ideas that this concept makes you think about? Input: To sustain means “give support to”, “to hold up”, “to bear” or to “keep up”. So sustainable is an <i>adjective</i> - a descriptive word- for something that is able to be sustained, i.e, something that is “bearable” and “capable of being continued”.</p>
20 minutes	<ol style="list-style-type: none"> 2. Ask: What do you think is something non-sustainable? Input: the word describes a situation in which human consumption or activities exceed the ability of the ecosystem to replenish or continue living over time. 3. Ask the learners what they think is wrong with non-sustainability. Why is sustainability important for the environment? 4. Invite learners to go around their house, grab 5 objects, and think about “the history of the object”. For example, if they grab a banana, encourage them to think about where and how that banana came from, how it was produced, how it was packaged, etc. <div style="text-align: center; margin: 10px 0;">  </div> <ol style="list-style-type: none"> 5. Guide the learner’s attention towards considering the following sources of electricity: hydroelectric power, coal power, nuclear energy, wind, and solar power. Invite learners to choose the source that interests them the most and draw/illustrate the steps of the process that they think/know it can be used to generate electricity. If learners worked on “Powering Against Blackouts- Part 1,” they will be familiar with some of the steps through which they generate electricity, otherwise, you can support them by keeping in mind this information: <p style="text-align: center;">Input:</p>

	<ul style="list-style-type: none"> ● Water or hydroelectric power is created using dams and, obviously, water. Water that is stored up behind the dam causes high-powered turbines (engines) to spin which in turn creates electricity. Because rain and snow runoff continually fill the reservoir behind the dam with water, dams are considered a source of renewable energy ● In a coal power plant, coal is mined and then transported to a boiler where it is burned. The heat released from coal boils water to make steam, which then passes through a turbine (engine) to make electricity. Much research has been done to determine the effectiveness of using coal for energy. Coal is inexpensive to use. However, for a typical coal power plant, large amounts of toxic (bad for our health) things like sulfur dioxide, carbon dioxide and mercury are released into the air, causing acid rain, greenhouse gases and other side effects that are harmful to people and the environment. Another concern is what we will use for energy when we run out of coal — there is estimated to be between 100- and 300 years' worth of coal supply remaining on the Earth. ● Nuclear energy comes from enriched uranium and provides more energy than the same amount of gasoline. Nuclear power plants use the power stored in the nuclei (the centre) of uranium atoms to heat up and boil water, and subsequently, to create steam. A steam turbine then generates electricity. There is not much pollution associated with nuclear power plants; however, the use of nuclear power is quite controversial, as there are risks to the environment and humans through the mining and transportation of uranium, as well as the storage of used uranium. ● Wind. Blowing wind turns enormous blades, which turn an electric motor and make electricity. There is a disadvantage with wind turbines that is similar to solar energy. You need to store the electricity that is created because it is not guaranteed that the wind will blow (to turn the blades) precisely when the power is needed. With each of these three types of renewable energy sources, there is little pollution to worry about cleaning up afterwards. ● Solar power uses photovoltaic (PV) panels to change sunlight into electric current to create electricity. One difficulty associated with PV panels is that power is still needed when the sun is not shining (i.e., having your lights or other electrical devices on at night); therefore, the electricity needs to be stored during the day for use at night, which is often expensive. <p>6. Invite learners to compare these resources based on their cost-effectiveness (how expensive - in terms of time, amount of resources,</p>
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20 minutes	<p>availability of the resources needed, infrastructure, technical requirements- it is to generate electricity using that source) and their sustainability. If it's easier, for their comparison, they may use this worksheet:</p> <table border="1"> <thead> <tr> <th>Type of Power Plant</th> <th>Requirements (Ex: fuel, sunshine, etc.)</th> <th>Cost (high or low)</th> <th>How Sustainable is it? (sustainable, not very sustainable, etc.)</th> </tr> </thead> <tbody> <tr> <td>Hydroelectric</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Solar</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Wind Turbine</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Nuclear</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Coal</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Natural Gas</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Discuss with the learners what they think is most important, providing inexpensive power that puts out emissions (pollution) that affect the environment and people's health but allows the community to have more reliable electric grids, or focusing on the development of clean energy at the expense of other improvements?</p> <p>Try to get learners to provide a good reason for choosing each of the alternatives (learners can also say that there is a compromise between the two alternatives).</p>	Type of Power Plant	Requirements (Ex: fuel, sunshine, etc.)	Cost (high or low)	How Sustainable is it? (sustainable, not very sustainable, etc.)	Hydroelectric				Solar				Wind Turbine				Nuclear				Coal				Natural Gas			
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Natural Gas																													

DAY 5

Today you will give recommendations for local officers

Suggested Duration	Activity and Description
10 minutes	<p>Theme: Recommendations for Local Officers.</p> <ol style="list-style-type: none"> 1. Invite students to rank the three most important consequences of blackouts in the community. Ask them to explain the criteria that they are using to say that one consequence is more important than the other one. For example, they might be using as their criteria "The community's economic well-being" or "risks for the environment" or "it affects me and the people that I love the most."
20 minutes	<ol style="list-style-type: none"> 2. Invite students to begin thinking about recommendations to solve these three consequences. Here are some questions to guide the learners: <ol style="list-style-type: none"> a. Based on their interviews and their learning so far, <ol style="list-style-type: none"> i. Where and when does the community have more demand for energy?

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10 minutes	<ul style="list-style-type: none"> ii. Based on this, are there ways that will help local officials balance supply and demand? What individual or group behaviours should be encouraged? iii. Are the blackouts affecting some people more than others? iv. Can everyone’s problem be addressed at the same time? v. Who should be prioritized in offering a solution?
10 minutes	<ul style="list-style-type: none"> b. How can the power grid and power plants be sustainable? c. Can they think about alternative sources of energy in their community? <p>3. Ask students to write down 3 recommendations for local officers who are willing to solve blackouts in your community.</p>
10 minutes	<p>4. Have students present to their families and/or classmates their recommendations and elicit feedback regarding</p> <ul style="list-style-type: none"> a. In what ways are they cost-effective? b. In what ways are they sustainable? c. In what ways are they scientifically sound? <p>5. Learners will use the feedback to polish the recommendations and, if possible, they will share the recommendations with local officials (they can present them, send the message, etc.). Invite learners to attach their newspaper articles to back the recommendations.</p>

Additional enrichment activities:	<p>Literacy extension:</p> <p><i>"Some 30 years ago, Buckminster Fuller came up with a plan to plug all the world's continents into the same electrical grid. The idea was to let power flow between countries. Energy companies then proceeded to build such a grid. To get the most use of their generation capacity and to maintain an emergency reserve, power companies found it efficient to connect their grids to their neighbor's, who then connected to their neighbor's.</i></p> <p><i>"The result, according to Peter Meisen of the Global Energy Network Institute, is that the electricity grids of all the nations of North and South America should be interconnected within the next 10 years.</i></p> <p><i>"...Once the [international] grid is fully functional, the only excuse for power shortages will be greed. When demand is high in one region, it's almost certain to be low in another. By making electric power as easily transferable as data, analysts</i></p>
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expect a global grid to smooth the market spikes out of the world's most useful commodity."

What will be the advantages and disadvantages of such a system? Should we be concerned that "...the only excuse for power shortages will be greed"?

ASSESSMENT CRITERIA

By the end of the project, most of my learners were able to:

- Use details and examples to support descriptions.
- Use facts to support claims and arguments.
- State the main idea and move from one idea to the next in a logical order, emphasizing main points in a focused, coherent manner.
- Suggest a set of scientifically sound, sustainable and cost-effective recommendations.

APPENDIX

- <https://mrelectric.com/blog/how-to-explain-electricity-to-a-kid-mr-electri>
- <http://www.wired.com/wired/archive/11.09/start.html?pg=17>
- <https://www.youtube.com/watch?v=v1BMWczn7JM>
- <https://www.nytimes.com/2021/02/18/learning/lesson-of-the-day-icy-storm-barrels-across-central-us-leaving-millions-without-power.html>
- <https://teachersinstitute.yale.edu/curriculum/units/1989/7/89.07.01.x.html>
- <http://lindseynicholson.org/wp-content/uploads/2012/09/energy-comparison.jpg>
- <https://learn.outofedenwalk.com/dialogue-toolkit/>
- https://www.teachengineering.org/lessons/view/cub_earth_lesson08