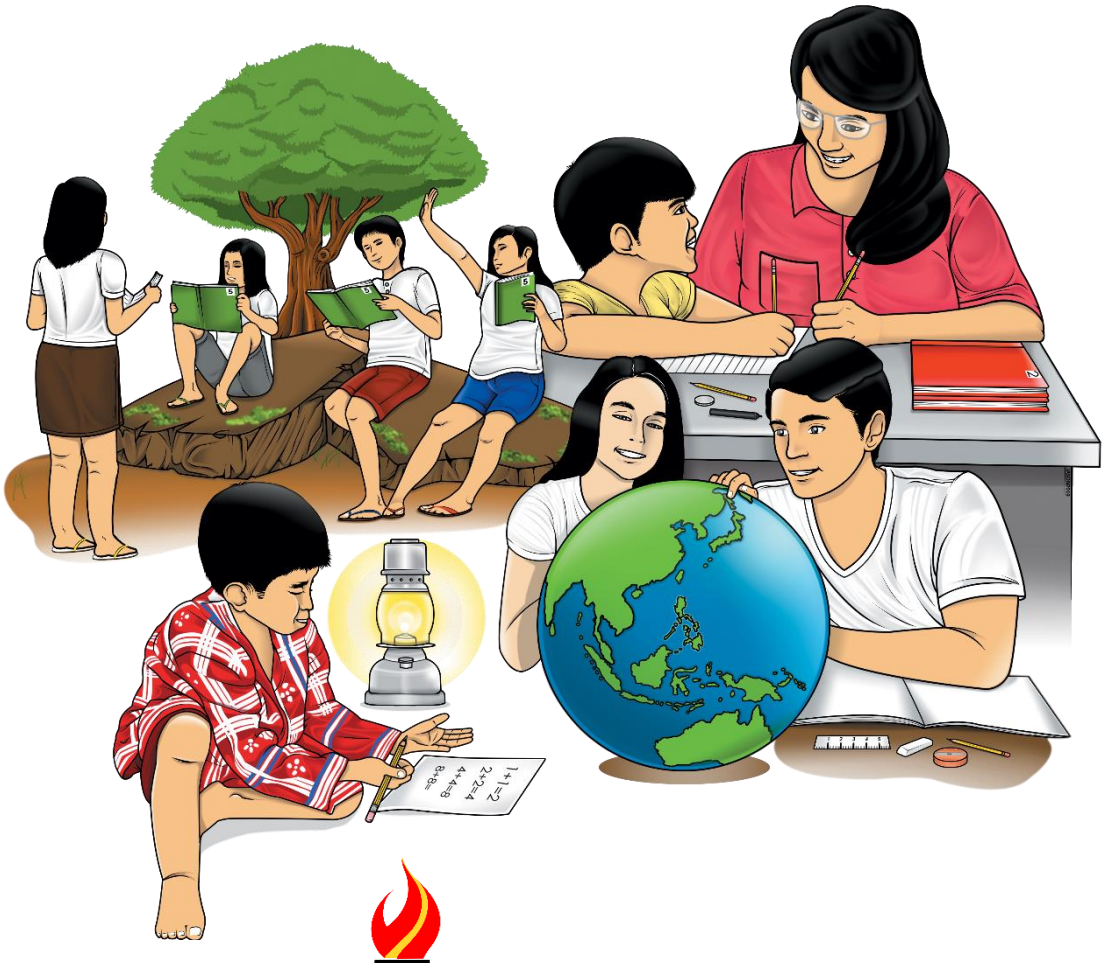
Senior High School

DepED
DEPARTMENT OF EDUCATION

Disaster Readiness and Risk Reduction

Quarter 2 – Module 3: Signs of Other Related Geological Hazards



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ADM

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

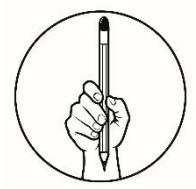
What I Need to Know

This module was designed and written with you in mind. It is here to help you master the Other Related Geologic Hazards. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The Module is intended to equip you with knowledge concerning signs of impending geological hazards.

After going through this module, you are expected to:

1. Recognize signs of impending geologic hazards.
2. Explain the mechanism underlying each of the common signs.
3. Appreciate the importance of knowing different geological hazards.



What I Know

Pre-test

Read each item comprehensively and write the letter of the correct answer on extra sheet of paper.

1. Which of the following is a natural sign of a possible landslide?
   a. curved tree trunks
   b. ants that gather food
   c. wilting of vegetation in a limited area
   d. moths flying in residential houselights

2. Which of the following is a natural sign of an impending sinkhole?
   a. curved tree trunks
   b. ants that gather food
   c. wilting of vegetation in a limited area
   d. moths flying in residential houselights

3. Which of the following areas is most prone to landslide?
   a. houses near rivers
   b. reactivated landslide areas
   c. concrete houses near a fault line
   d. residences near the satellite towers

4. Which of the following indicates that the whole region is unstable?
   a. absence of bird nests
   b. remnants of dead trees
   c. dark brown colored soil
   d. scarps and deposits of old landslides

5. Which of these indicate movement of geologic material that results to long cracks and deformation of road segments?
   a. land cracks
   b. stress cracks
   c. seismic cracks
   d. tension cracks

6. Which of the following pertain to a patch of angled forest on a slope?
   a. tilting trees
   b. sloping trees
   c. tropical forest
   d. crooked forest

7. Which of the following is NOT a sign of slow shifting inside structures?
   a. tilting of floor
   b. creaking and cracking
   c. swaying hanging objects
   d. doors not closing properly

8. Which of the following is the reason why seeps and springs suddenly appear as indication of a landslide?
   a. up welling
   b. damaged water ways
   c. burrowed holes of animals
   d. water seeping underground

9. Which of the following precedes a debris flow?
   a. low water level
   b. high water level
   c. moderate water level
   d. water temperature increases

10. Why does the presence of sinkholes produce earthly odor in home after rain?
   a. because the soil is dissolved
   b. because rain mixes with soil
   c. because vapors of rainwater fill the void
   d. because the water travels further underground

11. Which of the following is NOT caused by soil shifting downwards as a sign of an impending sinkhole?
   a. foundations that slant
   b. cracks in interior walls
   c. soil temperature changes
   d. trees or fence posts that fall

12. Which of the following signs is distinct to sinkholes?
   a. sudden drainage of a pond
   b. cracks around doors and window frames
   c. separation between walls and ceiling floors
   d. presence of odd bugs like slugs and centipedes in the home

13. Which of the following statements is true about signs of impending geologic hazard?
   a. Each sign immediately leads to a landslide or a sinkhole.
   b. It threatens the lives of humans and assure damage to property.
   c. Any of the signs can occur without the presence of a geologic hazard.
   d. Geologic hazard will surely occur if one of the signs is present.

14. Which of the following is NOT a sign of an impending landslide?
   a. things moving
   b. tension cracks
   c. change in water flow
   d. discolored well water

15. What causes the cracks produced by extensional stress found on flat ground?
   a. faults
   b. landslides
   c. sinkholes
   d. tsunami

Lesson 3 Signs of an Impending Geologic Hazard

Geologic hazards are unpredictable but their occurrence can be determined. In this module we will tackle signs of an impending geologic hazard namely for landslides and sinkholes.

Whenever two or three signs are evident in a particular place, people should be warned to evacuate or be ready for the occurrence of a landslide or a sinkhole. Being aware of these signs will make the students alert of what they observe in their surroundings.

These signs may be apparent in areas where there is a high risk of landslide or sinkhole, but other indications may only be due to changing weather. It should be viewed with caution in order to determine a logical evacuation plan, appropriate actions to prepare for the potential dangers, and to avoid loss of life and properties.

Prevention is still better than cure in situations of impending disasters. Rather than feeling sorry at the end, it's better to be aware of the possible hazards that can bring eminent disaster.

What's In

Activity 1: Increase or Decrease

Directions: Determine the correct relationship between the statements below by choosing the best answer inside the parentheses.

1. The presence of more plants (increases, decreases) the vulnerability of an area to landslides.
2. High and frequent rainfall (increases, decreases) the occurrence of a geologic hazard.
3. Earthquake on an uphill area (increases, decreases) exposure to landslides.
4. Extremely dry weather can (increase, decrease) the occurrence of sinkholes.
5. Heat during a wild fire (increases, decreases) the hydrophobic capacity of the soil.
6. The decrease in size of the void underneath the ground (increases, decreases) the size of the sinkhole.
7. The presence of clay (increases, decreases) the occurrence of a landslide.
8. A broken water pipe underneath a residential area can (increase, decrease) internal erosion.
9. Damp soil (increases, decreases) the surface tension of the particles.
10. Water-saturated soil (increases, decreases) pore spaces between the soil particles.

What's New

Activity 2: Explain your answer.

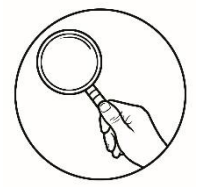
Directions: Make a brief explanation for each of the following questions.

1. Based on the bad experiences of people during landslides or sinkholes, do you think people were ready when they encountered them?
   _____
   _____
   _____

2. What were the noticeable signs that there would be a landslide or a sinkhole?
   _____
   _____
   _____

3. Did the PHIVOLCS give warning to the people about the possible dangers of a landslide or sinkhole in your area?
   _____
   _____
   _____

4. What do you think are the signs of an impending landslide or sinkhole? Why do you think it is essential to have signs for an impending landslide or sinkhole?
   _____
   _____
   _____



What is It

SIGNS OF IMPENDING LANDSLIDE OR SINKHOLE

Signs of impending landslides and sinkholes are observed on man-made infrastructures, bodies of water, and vegetation.

This list does not cover every possible indication of an impending landslide, nor does anything on this list trigger a landslide immediately. It contains warning signs that are listed to help people recognize when it's time to hire an expert to assess a slope's stability, or to make people more aware that something is wrong.

The Philippines is located in an archipelago characterized by having mountainous terrains and is often visited by typhoons which bring heavy rain. These two conditions combined in the most unfavorable manner may cause landslide which is a potential geologic hazard due to the topographic and geologic composition of land.

Landslide and sinkholes are two of the most common geologic hazards. Given that a disaster can happen anywhere and anytime, you should keep yourself familiar of the common signs related to geologic hazards, and signs that would possibly alert people that there is an impending landslide or sinkhole.

WARNING SIGNS OF AN IMPENDING LANDSLIDE

1. Earlier landslide as indicator
   - ✓ If there's frequent occurrence of landslides in a section, it implies that the soil in this area is weak and has unstable geology; thus, more susceptible to landslides. This may be caused by lack of vegetation, weathering, erosion, etc.
   - ✓ Multiple landslide events within the same place are retrogressive, piecemeal, or reactivated.
   - ✓ A reactivated landslide is when an old, semi-stable landslide changed something, causing a new collapse at the same place.
   - ✓ Inspecting an area of an old landslide for scarps and deposits is a clear indicator that a landslide will reactivate. This is also a sure sign that much of the region's underlying geology is fragile and vulnerable to landslides.

Washington State Department of Natural Resources. (2011). *Earthquake Reactivated Landslide Near Tacoma.* Photograph. https://www.flickr.com /photos/35433815@N08/5487422450. Licensed under CC BY-NC-ND 2.0 https://creativecommons.org/licenses/by-nc-nd/2.0/?ref=ccsearch&atype=rich

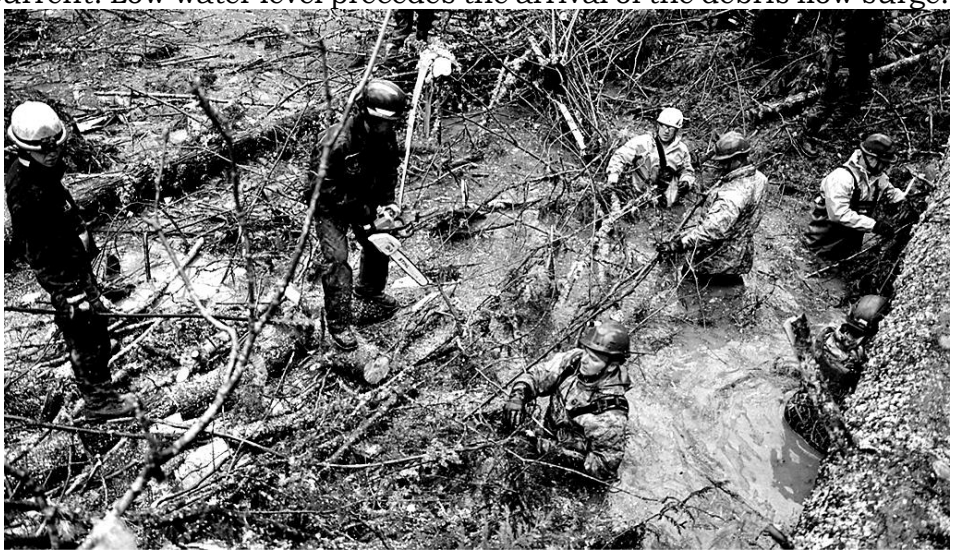
2. Tension cracks
   - ✓ These are caused by the stress and friction produced by geologic materials moving apart which forms steep lines of cracks in the terrain.
   - ✓ Tension cracks above an existing landslide can hint at a future reactivation.
   - ✓ These cracks are located on higher elevated ground.
   - ✓ Cracks that are found on flat terrain are caused by fault movement and not landslide indicators.

Klimets, Danny (2009) *Tension Cracks.* Photograph. https://search.creativecommons.org/photos/6902a3cb-cc5a-45ec-9b51-3a0b0b4457ed. Licensed under CC BY-NC-ND 2.0. https://creativecommons.org/ licenses/by-nc-nd/2.0/?ref=ccsearch&atype=rich

3. Things Moving
   - ✓ Deformation and movement of non-living objects not caused by human manipulation can also indicate a landslide.
   - ✓ The most common of these is that trees are bending up in a J-curve as a sign that the ground slips out from underneath them.
   - ✓ A patch of angled forest on a slope or J-curved trees somewhere can be a good indicator that the ground is less solid than it seems.
   - ✓ no longer closing properly, or broken utilities
   - ✓ This motion can be slow or rapid. Rapid landslides are results of sudden collapse of a slope. This happens in terrains that are steeper uphill. Indicators of slow landslides are categorized by movement of floor tiles, deformation of door frames which causes difficulty in closing and opening the door, and broken electric posts, gas, water and sewage pipes.
   - ✓ Creaking and cracking can also be warning signs.

Lisa (2013) *Crooked Forest 2.* Photograph. https://www.flickr.com/photos/88364173@N00/9462172851. Licensed under CC BY-NC 2.0. https://creativecommons.org/licenses/by-nc/2.0/?ref=ccsearch&atype=rich

4. Water Doing Something Different
   - ✓ There are obvious changes in water flow.
   - ✓ Springs, seep, or wet ground may appear on a seemingly dry terrain. Similarly, unexpected withdrawal of water also indicates the same. Water causes alteration of the pressure within the slopes of a terrain.
   - ✓ A debris flow is a very wet, very mobile landslide, where water is loaded with trees, mud, rock, and everything else caught in the current. Low water level precedes the arrival of the debris flow surge.



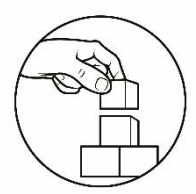
Featherston, R. (2014). "Oso Mudslide [Image 3 of 4]". Photograph. https://www.dvidshub.net/image/1206742/oso-mudslide#.Uzl7cF5RHig#ixzz2xYCpuuB3. Licensed under CC BY 2.0. https://creativecommons.org/licenses/by/2.0/?ref=ccsearch&atype=rich

WARNING SIGNS OF AN IMPENDING SINKHOLE

The occurrence of sinkholes and landslides may have something in common because they are both geologic hazards. Here are some signs of an impending sinkhole.

- Trees or fence posts that tilt or fall
- Foundations that slant
- New small ponds that appear after rain
- Cracks in the ground
- Sudden drainage of a pond
- Rapid appearance of a hole in the ground
- Dips, depressions, slopes that appear in a yard
- Dead patches of grass or plants
- Sinkholes in the neighborhood
- Wilted vegetation in a limited area
- Well water that is discolored or contaminated with debris
- Cracking or buckling of home's concrete slab
- Presence of odd bugs like slugs, centipedes in homes
- Earthly odor in home after rain
- New or widening cracks
- Separation between walls and ceiling or floors
- Cracks around door and window frames
- Cracked grout between tiles
- Cracked tiles
- Stair step cracks in blocks or bricks
- Uneven floors, warping of hardwood, bulging or sagging sections
- Doors or windows that don't open or close easily
- Cracks in sheetrock near doors or windows

All homes are subject to some settling characteristics. Signs of an impending geologic hazard may or may not always cause a landslide or a sinkhole. Still, two or more of these signs may indicate something wrong happening in the area, which alerts people to be careful of possible dangers that it may cause.



What's More

Activity 3:

Directions: Fill in the blanks to complete the statements.. Write your answer on a separate sheet of paper.

1. Multiple landslide events in the same place can be _____, _____, or _____.
2. _____ are created by the stress of geological material pulling apart.
3. _____ trees are a patch of angled forest on a slope
4. Water levels on a creek suddenly dropping can be due to _____.
5. _____ is a very wet, very mobile landslide, where water is loaded with trees, mud, rock, and everything else caught in the current.

What I Have Learned

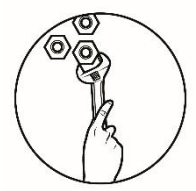
Now that you have learned the different signs of geologic hazards, let us now test your comprehension regarding the topic. Complete the following statements.

WARNING SIGNS OF AN IMPENDING LANDSLIDE

There are different warning signs of an impending sinkhole; some signs are_____ _____. When these signs are present, we can _____.

WARNING SIGNS OF AN IMPENDING SINKHOLE

There are different warning signs of an impending sinkhole, some signs of sinkholes are _____. When these signs are present we can _____.



What I Can Do

Activity 4:

Directions: Check out your own house and go around your place and try to look for signs that indicate whether it is prone or not to landslides and sinkholes. Create an investigative essay about your findings.

Indicate the specific signs that you have observed, their location and why you think they are signs of landslides and sinkholes and not just a mere damage caused by non-geologic hazards.

Rubrics in scoring the activity

5	4	3	2	1
90-100% completeness of content demonstrating illustrative strong development of ideas	80-89% completeness of content with adequate explanation of ideas	70-79% completeness of content with inadequate explanation of ideas	60-69% completeness of content with minimal explanation of ideas	59% and below completeness and Irrelevant explanation of content

Read each item comprehensively and write the letter of the correct answer on extra sheet of paper.

1. Which of the following is the reason why seeps and springs suddenly appear as indication of a landslide?
   a. upwelling
   b. damaged water ways
   c. burrowed holes of animals
   d. water seeping underground

2. Which of the following is NOT a sign of slow shifting inside structures?
   a. tilting of floor
   b. creaking and cracking
   c. swaying hanging objects
   d. doors not closing properly

3. Which of the following statements is true about signs of impending geologic hazard?
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4. Which of the following is NOT a sign of an impending landslide?
   a. things moving
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5. Which of the following is NOT caused by soil shifting downwards as a sign of an impending sinkhole?
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   c. soil temperature changes
   d. trees or fence posts that fall

6. Which of the following signs is distinct to sinkholes?
   a. sudden drainage of a pond
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7. Which of the following is a natural sign of an impending sinkhole?
   a. bent tree trunks
   b. ants that gather food
   c. wilting of vegetation in a limited area
   d. moths flying in residential houselights

8. Which of the following is a natural sign of a possible landslide?
   a. bent tree trunks
   b. ants that gather food
   c. wilting of vegetation in a limited area
   d. moths flying in residential houselights

9. Cracks found on flat ground created by extensional stress are caused by:
   a. faults
   b. landslides
   c. sinkholes
   d. tsunami

10. Why does the presence of sinkholes produce earthly odor in home after rain?
   a. because the soil is dissolved
   b. because rain mixes with soil
   c. because vapors of rainwater fill the void
   d. because the water travels further underground

11. Which of these indicate movement of geologic material that results to long cracks and deformation of road segments?
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   c. seismic cracks
   ` d. tension cracks

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    a. slope trees
    b. tilting trees
    c. tropical forest
    d. crooked forest

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    c. concrete houses near a fault line
    d. residences near the satellite towers

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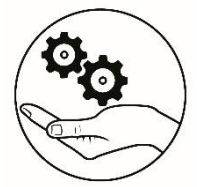
    b. remnants of dead trees
    c. dark brown colored soil
    d. scarps and deposits of old landslides

15. Which of the following precedes a debris flow?
    a. low water level
    b. high water level
    c. moderate water level
    d. water temperature increases



Additional Activities

Enrichment Activity

Instructions: Prepare your own ***Family Emergency Plan*** in case of a landslide. Once that the task is accomplished, share it with your family and start conducting drills.
This plan should include the following:
- a floor plan of your home
- indication of escape routes (at least three)
- rendezvous after evacuation
- essay paragraph explaining the steps in evacuation
- checklist of what to bring when you evacuate

Criteria's	4	3	2	1	TOTAL SCORE
Focus	All information is distinct and focused on the topic.	Most of the information is distinct and focused on the topic.	Some of the information is relevant to the topic.	Very little of the information is focused on the topic.	
Organization	With exceptional arrangement of content and subtle transitions.	One or two of the content is in logical order with some evidence of transition.	Inconsistent arrangement of content with no transition.	No evident arrangement of ideas.	
Required Elements	The narrative includes required elements as well as additional information from their personal perspective.	All required elements are included on the essay	All but 1 are included on the essay	Several required elements are missing	
Content	All content is strongly interconnected and developed with adequate explanation supported with documentation.	Most of the information is sufficiently developed and explained adequately, with proper documentation.	Some of the content limited with inadequate elaboration of the explanation with some documentation.	Very little of the content is relevant to the topic and has no documentation.	

Answer Key

What I Know

1. A
2. C
3. B
4. D
5. D
6. D
7. C
8. B
9. B
10. C
11. C
12. D
13. C
14. D
15. A

What's In

1. Decreases
2. Increases
3. Increases
4. Increases
5. Increases
6. Decreases
7. Increases
8. Increases
9. Increases
10. Increases

Assessment

1. B
2. C
3. C
4. D
5. C
6. D
7. C
8. A
9. A
10. C
11. D
12. D
13. B
14. D
15. B

What's More

1. retrogressive, piecemeal, or reactivate
2. Tension cracks
3. J-curved
4. an upstream obstruction like a landslide
5. Debris flow

References

Disaster Readiness and Risk Reduction,DepEd

Featherston, R. (2014). "Oso Mudslide [Image 3 of 4]". Photograph. https://www.dvidshub.net/image/1206742/oso-mudslid e#.Uz l7cF5R Hig#ixzz2xYCpuuB3. Licensed under CC BY 2.0. https://creativecommons. org/licenses/by/2.0/?ref=ccsearch& atype=rich

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