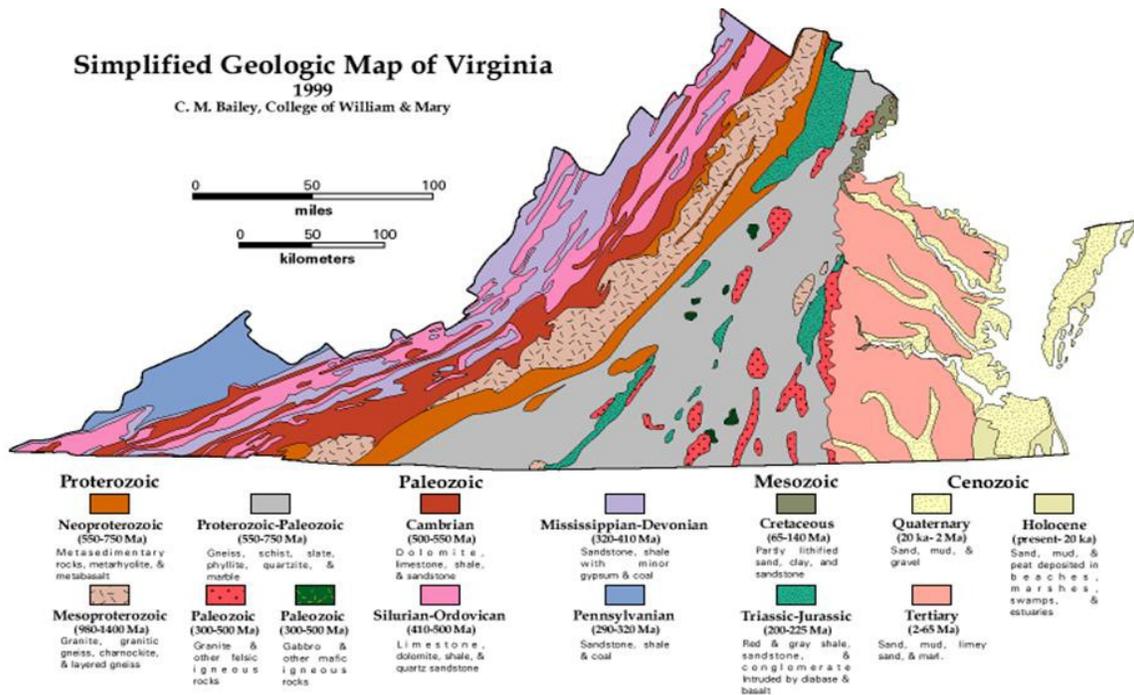


“Evidence of our Environmental Impact on Climate change in Virginia”

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Summary

The case study is for lower level, general education (inclusive) undergraduate students taking an Environmental Studies Course as an elective. The Earth Science course used for this case study generally ranges from 20 to 30 students per semester. Ten weeks (one day a week) will be allocated for the study. The first five weeks will require students to complete labs and activities building up to the case study. The final 2 weeks are for the students to collaborate and present their final recommendations.

Read the case study provided in the Resources and use as a guide for developing a plausible recommendation to the Global warming issues of the selected area. See the attachment for guidelines and labs. The goal of the labs and activities is for the students to obtain an

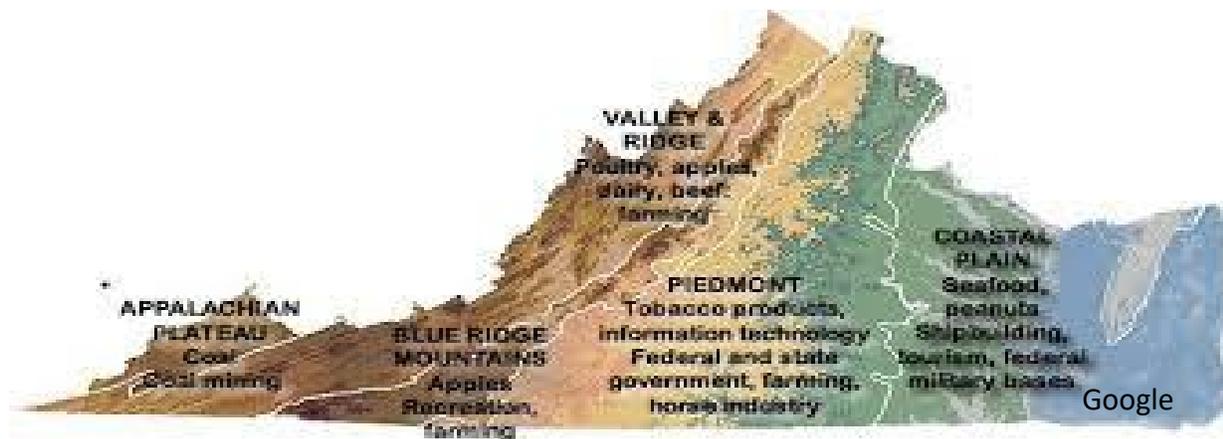


Teacher Notes

understanding of how the effects of climate vary within the regions of Virginia and to aid in finding information to support the feasibility of their recommendations. Once the assignments are completed and the learners have some related background on climate related issues, they may begin work on the case study. Each student is to present a case study analysis describing his or her mitigation and adaptation proposal. They are to select a city (provided in the listing) and develop their case study around that geographic area. In doing this, the students will document the signs of increased global warming; explain the impact of this event, (decline in tourism, the fishing industry and possible employment). Finally, they are to propose a viable solution to aid in the minimization or slowing the effects of global warming in their selected region.

Constructive feedback for this case can be sent to escience03@gmail.com.

Use the example case study to provide the students with some guidance on what to include in their study. (Resource Area)



Virginia Five Topographic regions



Teacher Notes

When compared to the rest of the United States, Virginia is considered to have a mild climate. The climate is variable due to the topographic differences and influence of the Atlantic Ocean. There are complex coastlines, mountain ranges and valleys that affect heat and precipitation. The Marsh/wetland/coastal areas, Agricultural areas, Inland areas, Island areas and Mountain regions are some of the most vulnerable parts of our ecosystem.

Virginia is behind in its development of climate related regulations. Although big corporations play a major role in promoting global warming, this study will focus on the small-scale impact of human induced factors. The case study is designed for an undergraduate general education course. This case study will focus on answering the following questions: **Why is the CO₂ level of the atmosphere increasing? Can your individual yearly CO₂ contribution be reduced, minimizing our carbon footprint? If yes, how do you propose to do this?** Read the case study below and write a case study analysis describing your mitigation and adaptation proposal. See the attachment for Guidelines and Labs.

You are to select a city from the list provided that geographically covers the remaining four topographic regions. You are also, required to either complete short lab experiments or do research to find the documentation to support the feasibility of your proposed solution. Your Primary goal is to obtain a better understanding of the effects climate change and offer a viable practical solution. See link below for more detail on signs of global warming in Virginia - <https://environmentvirginiacenter.org/page/vac/what-global-warming-means-virginia>



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Teacher Notes

Virginia Climate Change Article – Condensed case study - Deliverables

<https://environmentvirginiacenter.org/page/vac/what-global-warming-means- Virginia>

Carbon Pollution is believed to be the catalyst fueling global warming. The study, “[Climate Change and Health in Virginia](#),” warns that as heat waves increase, the risk of heat-related illnesses and deaths in Virginia will grow. Coastal flooding, which [already threatens Norfolk and the Hampton Roads area](#), is likely to worsen as sea levels rise, potentially impeding emergency medical services. Allergy season is starting earlier and lasting longer, and asthma attacks are increasing in the southeastern United States. This case study will focus on offering ways to mitigate and reduce our carbon footprint. (See Student Handout 1).

- The goal is to obtain a better understanding of climate change effects across Virginia.
- Students will be capable of sifting through the facts, analyzing the problem and considering possible solutions, and their likely consequences.
- Students should be able to apply a viable solution for reducing CO₂.
- The ultimate goal is to have the students walk away with some sense of socio-environmental awareness and how their choices can influence the community in they live.

At the beginning of the course, students will be instructed to use the foot print calculator and again at the end to determine whether their attitude on the global foot printing has changed.

[Footprint App](#)

Completed at both the start and end of the course.

Go to Footprintcalculator.org complete the survey and save your results to a pdf. (Dynamic assessment).

Lab Activities: A textbook is required for the labs. These lab activities are subject to change as the course is improved upon and the lab textbook changes.

Activities: to be completed prior to beginning your case study research completing a few labs
– See student sheet for instructions.



Teacher Notes

- Five Regions of Virginia Lab - Geology
- Geology- Minerals and Rocks
 - Shaping the earth surface: Running and Groundwater and Arid Landscapes
- Oceanography - Waves, currents and Tides
- Meteorology - Heating the atmosphere
 - Atmospheric Moisture, Pressure and Wind
 - Global Climates

Select an area in Virginia to Research for your case:

Case Study Activities:

1. **Choose a study area** – see list

Roanoke	Richmond	Fairfax	Blacksburg	Suffolk	Christiansburg
Charlottesville	Alexandria	Lynchburg	Petersburg	Staunton	Norton-Wise
Williamsburg	Danville	Newport News	Waynesboro	Lexington	Front Royal
Arlington	Martinsville	Winchester	Abingdon	Radford	Eastern Shore
Fredericksburg	Bristol	Harrisonburg	Culpeper	Blacksburg	Tidewater Area

2. **Select an issue related to climate change** – describe a Global warming issue that you would like to address.
3. **Research it** – Compile what you know about the issue. Use the Internet, textbooks, etc. Cite your references.
4. **Brainstorm solutions** – Provide multiple ways to address the issue.
5. **Choose a solution** - Provide a realistic- fact based solution to your issue. (Written report)
6. **Create an Action Plan** – Provide steps to put your solution into action. Explain the resources that you would need.
7. **Share your idea** – Create a 15-minute multimedia presentation to share with the class.
 - a. Introduce your topic
 - b. Provide background information
 - c. Describe your solution
 - d. Explain its effectiveness
 - e. Detail the steps of your action plan



Teacher Notes

Deliverables:

Your completed labs. The final compilation of the case study should be displayed on either a PowerPoint or ESRI story map, explaining or describing your proposed plan.

Resource Files/Folders:

Teacher Notes

Students Notes

Additional Resources

There will be no answer key, for the case study segment, your answers may vary. This course is using the dilemma approach in which the students will provide a resolution and recommendation, to the problem. There are no correct answers.

ASSESSMENTS

Each of the labs will be done according to the instructions provided by the instructor; the procedure may need to be modified to fit the constraints of the course. The lab notes and procedures can be found in the required textbook.

Lab Activities: Lab textbook required –

“Applications and Investigations in Earth Science”, 9th Edition, Authors: Tarbuck and Lutgens; ISBN 13: 978-0-13-474624-1

Activities: to be completed prior to beginning your case study research completing a few labs – See student sheet for instructions.

- Five Regions of Virginia Lab - Geology
- Geology- Minerals and Rocks – Chapters 1 and 2
 - Shaping the earth surface: Running and Groundwater and Arid Landscapes –Chapters 8 and 9
- Oceanography - Waves, currents and Tides – Chapter 12
- Meteorology - Heating the atmosphere - Chapter 23
 - Atmospheric Moisture, Pressure and Wind – Chapter 15
 - Global Climates – Chapter 17



Five Regions of Virginia activity is included to assist the student in obtaining an understanding of the study area. In this course, the Commonwealth of Virginia will be the region of interest. See attached file entitled “*Five Regions of Virginia*” Activity.

Participation Rubric:

Evaluation Rubric: Student Participation weekly Evaluation

Level of participation	Score
None: Student was absent or, if present, did not actively participate	0
Unacceptable: Student either did not complete evaluations or provided only superficial feedback	1
	2
Acceptable: Student completed all evaluations, with some evidence of substantial feedback	3
	4
Outstanding: Student provides substantive feedback to all items	5

Note: Maximum total Rubric score for course is 100 points. $50 \times 2 = 100$ 50 represent the total points that can be accrued for the semester.

Once a score is applied, you have 1 week to question your score.

Lab Grades and Assessment:

Activity	Description	Instructions	Assessment	Grade points	Completed
Lab1	Rocks & Minerals	See activity folder	Graded based on accuracy, summarized	125	
Lab2	Groundwater & Landscapes	See activity folder	Graded based on accuracy, summarized	125	
Lab 3	Oceanography	See activity folder	Graded based on accuracy, summarized	125	
Lab 4	Meteorology	See activity folder	Graded based on accuracy, summarized	125	
Lab 5	Global Climates	See activity folder	Graded based on accuracy, summarized	100	
Activity VA	Five regions in Virginia	See activity folder	Graded based on accuracy, summarized	100	
Case Study	Begin work on Research Area	See activity folder	Rubric	300	
Total points				1000	



Use the rubric as a guide for your response

Point grading system for the Rubric is (100-90)16=A; (89-80)12=B; (79- 70)8=C; (69-60)4=D; (<60)0=F

RUBRICS:

Assessment Criteria	SCORE			
	1- Inadequate	2- Developing	3- Proficient	4 - Excellent
Statement of position on Global warming	Not clear on position	Has made a slight choice	Clearly expresses your choice	Has researched thoroughly, shows a clear understanding, and is comfortable speaking about the topic.
Content on response	No clear solution is presented.	A solution is presented in a confusing manner.	Has adequately researched and is knowledgeable about the topic.	Conveys a clear solution while addressing implementation challenges.
Explanation	The writer does not understand.	The writer has difficulty of understanding.	Has adequately researched and is knowledgeable about the topic.	Consistently and clearly supports your decision
Organization	Response is confusing and difficult to follow.	Response is difficult to follow and there is limited organization of information.	Writer can follow most of the speaker's reasoning.	Writer can easily follow the line of reasoning. Ideas are well thought out.

Assessment Rubric for Case Study:

ASSESSMENT CRITERIA	SCORE			
	1—INADEQUATE	2—DEVELOPING	3—PROFICIENT	4—EXCELLENT
Preparation	Unprepared for presentation. Hasn't researched and lacks understanding of the topic.	Has done some research. Shows some inaccuracies in knowledge of the topic.	Has adequately researched and is knowledgeable about the topic.	Has researched thoroughly and shows a clear understanding of and is comfortable speaking about the topic.
Content	No clear solution is presented. Information, findings, and evidence are not factual. No sources are cited.	A solution is presented in a confusing manner and implementation challenges are not addressed. Not all information, findings, and evidence are accurate. Few sources are cited.	Conveys a clear solution, but implementation challenges are not addressed. Information, findings, and supporting evidence are given, but sources are not always cited.	Conveys a clear solution while addressing implementation challenges. Presents appropriate information, findings, and evidence to support ideas. Several sources are cited.
Presentation	Speaks inaudibly so that the audience can't hear or understand the presentation. Doesn't make eye contact and reads mostly from notes. Mostly uses informal or inappropriate language.	Speaks at an inconsistent volume or speed so that the audience has difficulty hearing or understanding presentation. Presenter heavily relies on notes. Frequently uses informal language.	Speaks clearly and loudly for most of presentation. Maintains eye contact most of the time but frequently refers to notes. Mostly uses formal and appropriate language.	Consistently speaks clearly and loudly while making eye contact with the audience and seldom using notes. Uses formal and appropriate language.
Visuals, Graphics, and Audio	Doesn't include interesting or relevant sources of media. Information presented in sources is inaccurate or inappropriate for audience.	Minimally includes media or media doesn't add constructively to presentation or support the topic.	Integrates some credible sources of media into presentation to support ideas and findings and add interest.	Strategically integrates media in a variety of formats to enhance understanding of findings, reasoning, evidence, and to add interest. Each source used is credible and the information accurate.
Organization	Presentation is confusing and difficult to follow. There is no clear organization. The development, substance, and style are not appropriate for the presentation's purpose, audience, and task.	Speaker's reasoning is difficult to follow and there is limited organization of information. The presentation's development, substance, and style rarely align with its purpose, audience, and task.	Listeners can follow most of the speaker's reasoning. Thought has been given to the order of information. For the most part, the presentation's development, substance, and style align with its purpose, audience, and task.	Listeners can easily follow the line of reasoning. Ideas are presented in a well-thought-out, logical sequence. The presentation's development, substance, and style align with its purpose, audience, and task.

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Note: 1= 25 points; 2= 50 points; 3= 75 points and 4= 100 points. The maximum points for each segment of the case study is 100 totaling 300 points.



Acknowledgements:

This work is supported by, the National Socio-Environmental Synthesis Center (SESYNC) under funding received from the National Science Foundation DBI- 1639145.

Supplemental Resources and References:

Storymap link: <https://storymaps.arcgis.com/>

Climate Change tools:

<https://www.climate.gov/teaching/resources/exploring-ncar-climate-change-data-using-gis>

<https://gisgeography.com/climate-change-effects-maps/>



Activity 1:

Five Region Activity from the Virginia Dept. of Education: This simplistic activity to provide students, which are not familiar with Virginia, an understanding of the complex geography.

Lab Activities: For space purposes, the labs will be taken from the following textbook. These labs can be modified to fit the course needs.

Lab textbook required –

***“Applications and Investigations in Earth Science”*, 9th Edition, Authors: Tarbuck and Lutgens; ISBN 13: 978-0-13-474624-1**

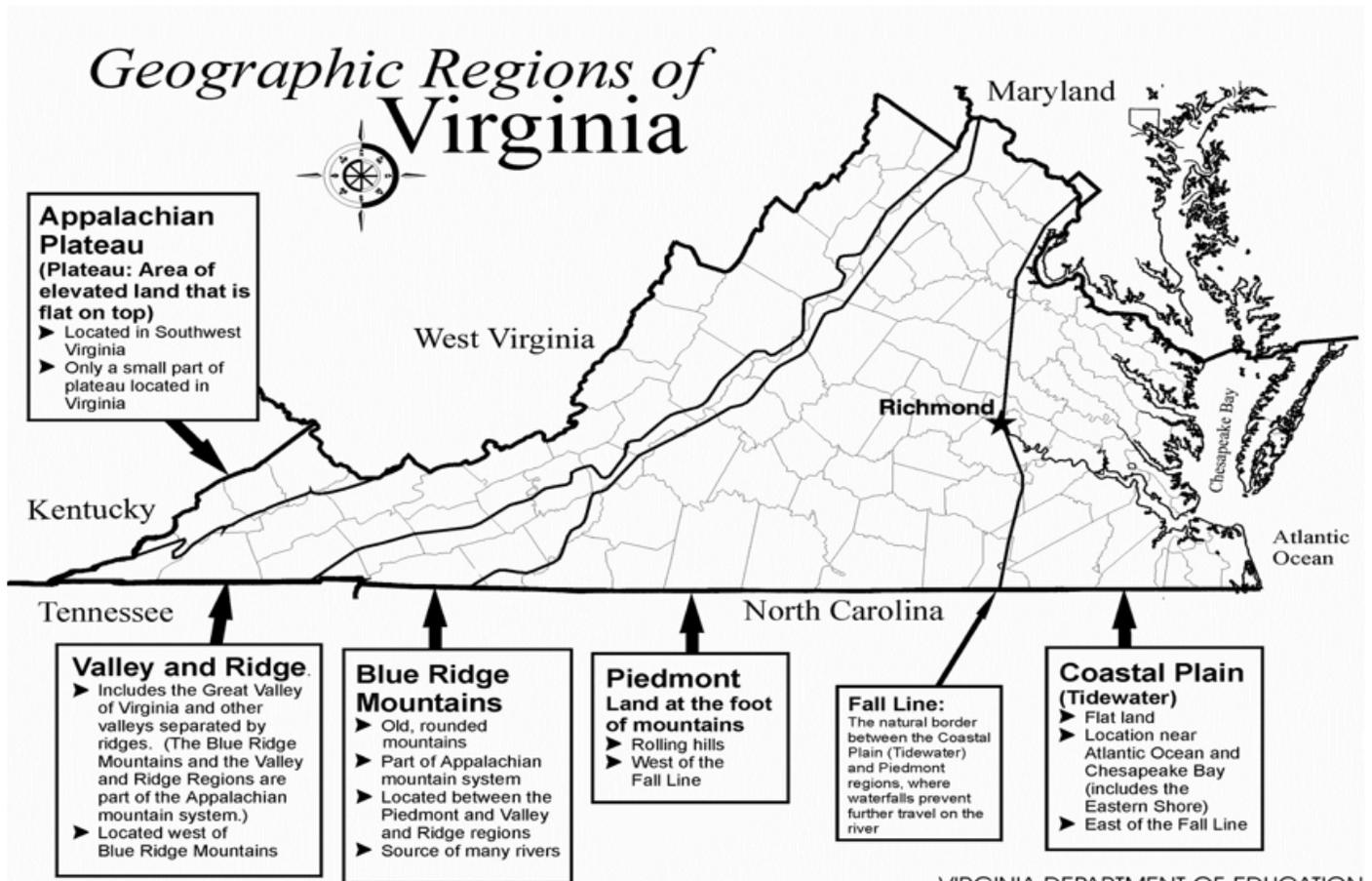
Activities: to be completed prior to beginning your case study research completing a few labs – See student sheet for instructions.

- Five Regions of Virginia Lab - Geology
- Geology- Minerals and Rocks – Chapters 1 and 2
 - Shaping the earth surface: Running and Groundwater and Arid Landscapes –Chapters 8 and 9
- Oceanography - Waves, currents and Tides – Chapter 12
- Meteorology - Heating the atmosphere - Chapter 23
 - Atmospheric Moisture, Pressure and Wind – Chapter 15
 - Global Climates – Chapter 17

Taken From Curriculum Framework: History and Social Science Standards of Learning Enhanced Sc History and Social Science Standards of Learning Enhanced Scope and Sequence: Virginia Studies ope and Sequence: Virginia Studies

http://www.doe.virginia.gov/testing/sol/frameworks/history_socialscience_frameworks/2008/2008_final/frameworks_virginia_studies.pdf

Attachment A: Geographic Regions of Virginia_



Attachment B: Coastal Plain (Tidewater) Graphic Organizer _____

Name: _____ Date: _____

The Coastal Plain (Tidewater) Region

Fall Line:

Land:

Location:

Geographic Regions of
Virginia



Shade in the Coastal Plain (Tidewater) region on the map.



Attachment D: Piedmont Graphic Organizer _____

Name: _____ Date: _____

The Piedmont Region

Fall Line:

Land:

Location:

Shade in the Piedmont region on the map.

Geographic Regions of
Virginia



Attachment F: Blue Ridge Mountains Graphic Organizer _____

Name: _____ Date: _____

The Blue Ridge Mountains Region

Additional Information:

Land:

Location:

Geographic Regions of
Virginia



Shade in the Blue Ridge Mountains region on the map.



Attachment H: Valley and Ridge Graphic Organizer _____

Name: _____ Date: _____

The Valley and Ridge Region

Additional Information:

Land:

Location:

Geographic Regions of
Virginia



Shade in the Valley and Ridge region on the map.



Attachment J: Appalachian Plateau Graphic Organizer _____

Name: _____ Date: _____

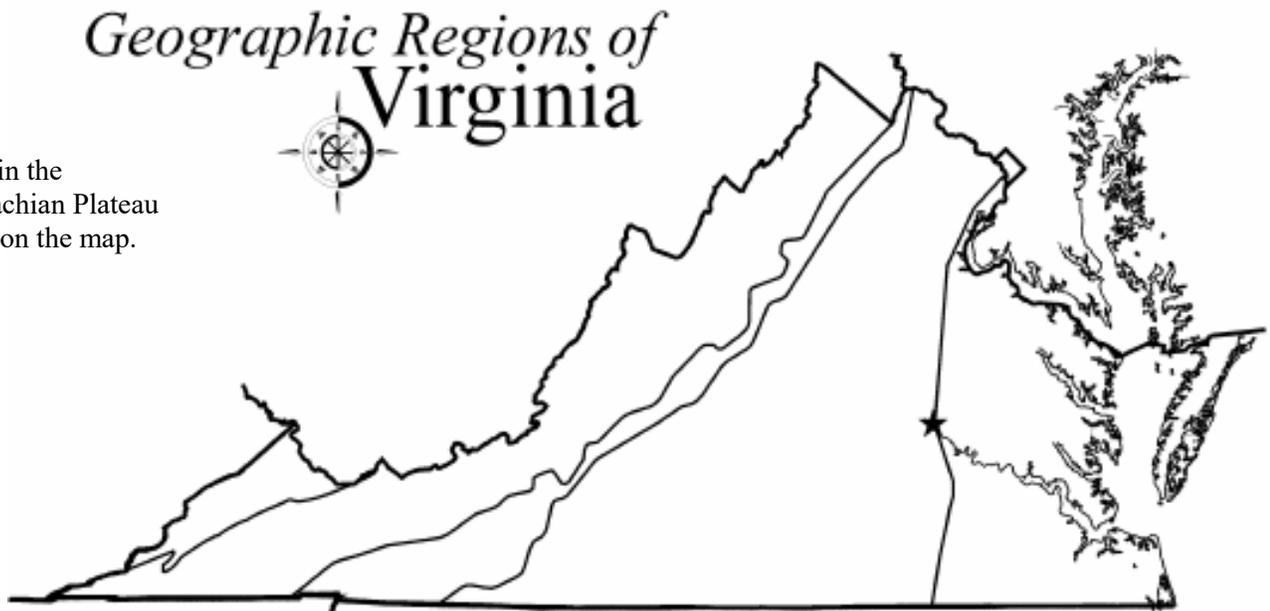
The Appalachian Plateau Region

Additional Information:

Land:

Location:

Shade in the Appalachian Plateau region on the map.



WATER FEATURES IN VIRGINIA IMPORTANT FACTS

Atlantic Ocean	—	Links Virginia to other places
Chesapeake Bay	—	Provided a safe harbor
	—	Was a source of food and transportation ¹
James River	—	Flows into the Chesapeake Bay
James River	—	Richmond and Jamestown located along the
York River	—	Flows into the Chesapeake Bay
	—	Yorktown is located along the York River
Potomac River	—	Flows into the Chesapeake Bay
River	—	Alexandria is located along the Potomac
Rappahannock River	—	Flows into the Chesapeake Bay
		Fredericksburg located along the Rappahannock River
Lake Drummond	—	Located in the Coastal Plain
(Tidewater) region		Shallow natural lake surrounded by the Dismal Swamp ²
Dismal Swamp	—	Located in the Coastal Plain
(Tidewater) region		- Home to a wide variety of wildlife

¹Each waterway was a source of food and provided a pathway for exploration and settlement.

²Early settlement patterns in the region were shaped by the Dismal Swamp

Resource: Case Study Example (condensed): The Tidewater Area is my study region of choice. You will be required to reference the Tidewater case study process and apply these steps to your own case. The presentation portion is not included.

Case study Example: Climate change in the Coastal Plains Areas (Tidewater) Virginia



https://www.richmond.com/weather/floods-fires-and-rising-seas-new-report-details-how-virginia/article_90a70d07-e988-5bde-837f-97053be61aae.html

Task – to present a community faced with a problem.

Introduce the problem

- Provide background of the problem

- Developments leading up to the crisis

 - Charts, tables, graphs, and documentation

- Complete the assigned activities associated with the case.

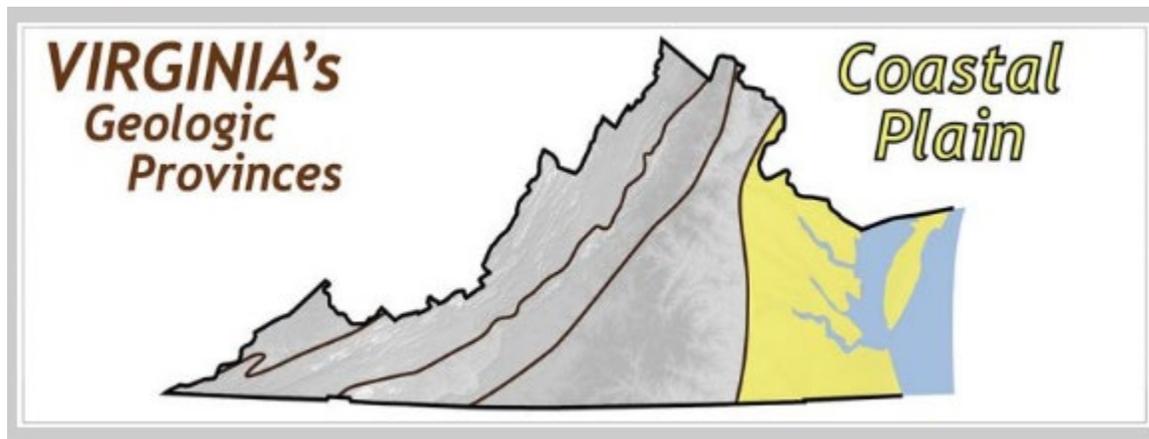
- Lay the foundation for a solution that may be integrated into the case.

Goal –

To obtain a better understanding of climate change and offer a viable solution. The students will sort through the data and facts; analyze the problem and their likely consequences. Offering a viable recommendation on how we can reduce our carbon footprint on the environment.

Problem – Effects of climate change

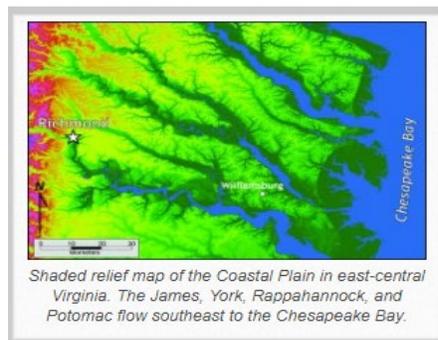
How climate change is affecting your environment and community. Scientist Projected, at The Nature Conservancy, that Virginia will be as hot as South Carolina by 2050 and Hot as northern Florida by 2100. Hotter temperatures contribute to the poor air quality that threatens to exacerbate existing health concerns; for example Asthma. Asthma affects 163,000 children 554,000 adults in Virginia. The regions employment industry is shipbuilding, tourism and military bases. The area also produces two major products, seafood and peanuts. Climate change is having an adverse effect on the economy in the coastal plain area.



<http://geology.blogs.wm.edu/coastal-plain/>

Research Background - Coastal Plain (Tidewater Area)

The Coastal Plain is a natural region in eastern Virginia, U.S., comprising a low-lying alluvial plain on the western shore of Chesapeake Bay between the Atlantic Ocean and the Fall Line (a line marking the junction between the hard rocks of the Appalachians and the softer deposits of the coastal plain). Climate change is increasing the number and intensity of drought and extreme heat events in the Coastal Plains/Tidewater area. Temperature Rise is more evident in the Coastal Region of Virginia. Some major indications are the continuation of sea level rising, Land subsidence and Shoreline erosion.



<http://geology.blogs.wm.edu/coastal-plain/>

The Coastal Plain system is uniquely structured. The salinity level, energy, moisture gradients, and the organisms are highly specialized. Sensitive to sea level rise, changes in the frequency and intensity of storms has resulted in the increase of precipitation, warmer ocean temperatures, and ocean acidification. Climate change causes shifts in coastal ecological conditions. This may support the spread of pathogens, parasites, and diseases; for example, – Starfish wasting disease – mass die-off of starfish. Large fluctuations in fish, bird, marine mammal, and reptile populations have been detected, during off seasons. Due to an increased El Nino, caused by increased atmospheric temperatures and sea surface temperatures, leads to decreased upwelling, and shifts in prey due to warmer water. Some additional signs of climate change or global warming is:

- Less snowfall more inland flooding
- Increase rainfall winter
- Decrease rainfall in summer
- Snowfall moves toward the spring season
- Looking into future more intense rainfall ,droughts, storms and flooding



Changes in precipitation and temperature regimes have the potential to disrupt agriculture and forestry.

Activities: to be completed prior to beginning your case study research

Completing a few labs – See student sheet for instructions.

- Five Regions of Virginia Lab - Geology
- Geology- Minerals and Rocks
 - Shaping the earth surface: Running and Groundwater and Arid Landscapes
- Oceanography - Waves, currents and Tides
- Meteorology - Heating the atmosphere
 - Atmospheric Moisture, Pressure and Wind
 - Global Climates

Questions to consider:

- Why should we be concerned about the “Earth Systems”?
- How do we negatively impact the “Earth Systems”?
- How can we positively impact the “Earth Systems”?
- Other than recycling, what are some other ways that humans can make changes so that the biosphere is not harmed?

Brainstorm Solutions:

- Geothermal Energy
- Wind Energy
- Preserving natural Habitats

- Carpool
- Conserve natural resources
- Reduce pollution
- Becoming more organic

Action Plan:

Reduce our usage of plastic bags and water bottles. If we remove a tree, replace it with smaller trees. Reduce CO₂ emission by ride sharing and carpooling. When destroying an area for growth and development be conscientious that we are displacing a natural habitat. Within our communities we need to use native plants and create small eco-environments. Do not improperly dispose of your waste (do not flush medication down the toilet or dump trash into the waterways).

Recommendations:

- Practice sustainability in our everyday living.
- Reduce pollution – by disposing of waste properly
- Learn how to share this planet with both the plants and animals.

Acknowledgements:

This work is supported by, the National Socio-Environmental Synthesis Center (SESYNC) under funding received from the National Science Foundation DBI- 1639145.