



## PART 1: Research

### Student Directions:

#### Your Assignment:

Your city council is researching the benefits of restoring a portion of the shoreline to its original salt marsh. You have the opportunity to speak at the next city council meeting. You will prepare your speech by watching videos, reading articles, and viewing an infographic to build your understanding of this topic. You will also be able to visit a coastal wetland, either live or virtually. Then you will answer several research questions and prepare what you will say at the next city council meeting.

#### Steps to complete:

To plan and compose your speech, you will do all the following:

1. Watch two videos.
2. Read two articles and study one infographic.
3. Answer three questions about the sources.
4. Investigate a coastal wetland.
5. Plan, compose and deliver your speech.

#### Directions for beginning:

Watch the videos, read the articles, and study the infographic. Take notes to help you answer the research questions and to help plan your speech. You can watch the video and read the sources as often as you like.

### Source Information

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- Video #1:** *Blue Carbon- A Story from the Snohomish Estuary* (5:47)  
[https://www.youtube.com/watch?v=Vzn5XO\\_GYLO&t=8s](https://www.youtube.com/watch?v=Vzn5XO_GYLO&t=8s)
- Video #2:** *Why Wetlands are Nature's Super Systems* (2:07)  
<https://www.youtube.com/watch?v=8Mm2tMlcEYE>
- Article #1:** *Blue Carbon and Wetlands* by Adelia Ritchie, Salish Magazine Autumn 2020 Reprinted from <https://salishmagazine.org/blue-carbon/>
- Article #2:** *US EPA Functions and Values of Wetlands*  
Reprinted from <https://www.epa.gov/sites/default/files/2016-02/documents/functionsvaluesofwetlands.pdf>
- Infographic #1:** *Coastal Blue Carbon*  
Reprinted from <https://www.earthcorps.org/key-initiatives/blue-carbon/>



Task: **Blue Carbon & Wetlands (Grades 9-12)**



**NOTE TAKING TOOL**

	<i>What are the benefits of wetlands?</i>	<i>What is blue carbon?</i>	<i>How can wetlands mitigate or help people adapt to a changing climate?</i>
<b>Video #1:</b> <i>Blue Carbon- A Story from the Snohomish Estuary</i>			
<b>Video #2:</b> <i>Why Wetlands are Nature's Super Systems</i>			



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	<i>What are the benefits of wetlands?</i>	<i>What is blue carbon?</i>	<i>How can wetlands mitigate or help people adapt to a changing climate?</i>
<b>Article #1:</b> <i>Blue Carbon and Wetlands</i>			
<b>Article #2:</b> <i>US EPA Functions and Values of Wetlands</i>			
<b>Infographic #1:</b> <i>Coastal Blue Carbon</i>			



Task: **Blue Carbon & Wetlands (Grades 9-12)**



**Article #1:** *Blue Carbon and Wetlands* by Adelia Ritchie, Salish Magazine Autumn 2020  
<https://salishmagazine.org/blue-carbon/>

A *wetland system* isn't just another lovely place for a nature walk. Wetland ecosystems protect us from storms and floods, they provide vital nursery grounds for fish and other marine life, and they are among the most productive ecosystems in the world, comparable to rain forests and coral reefs. An immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals compose our local wetland ecosystems. And wetlands can even reveal the history of earthquakes and tsunamis in their sediments.

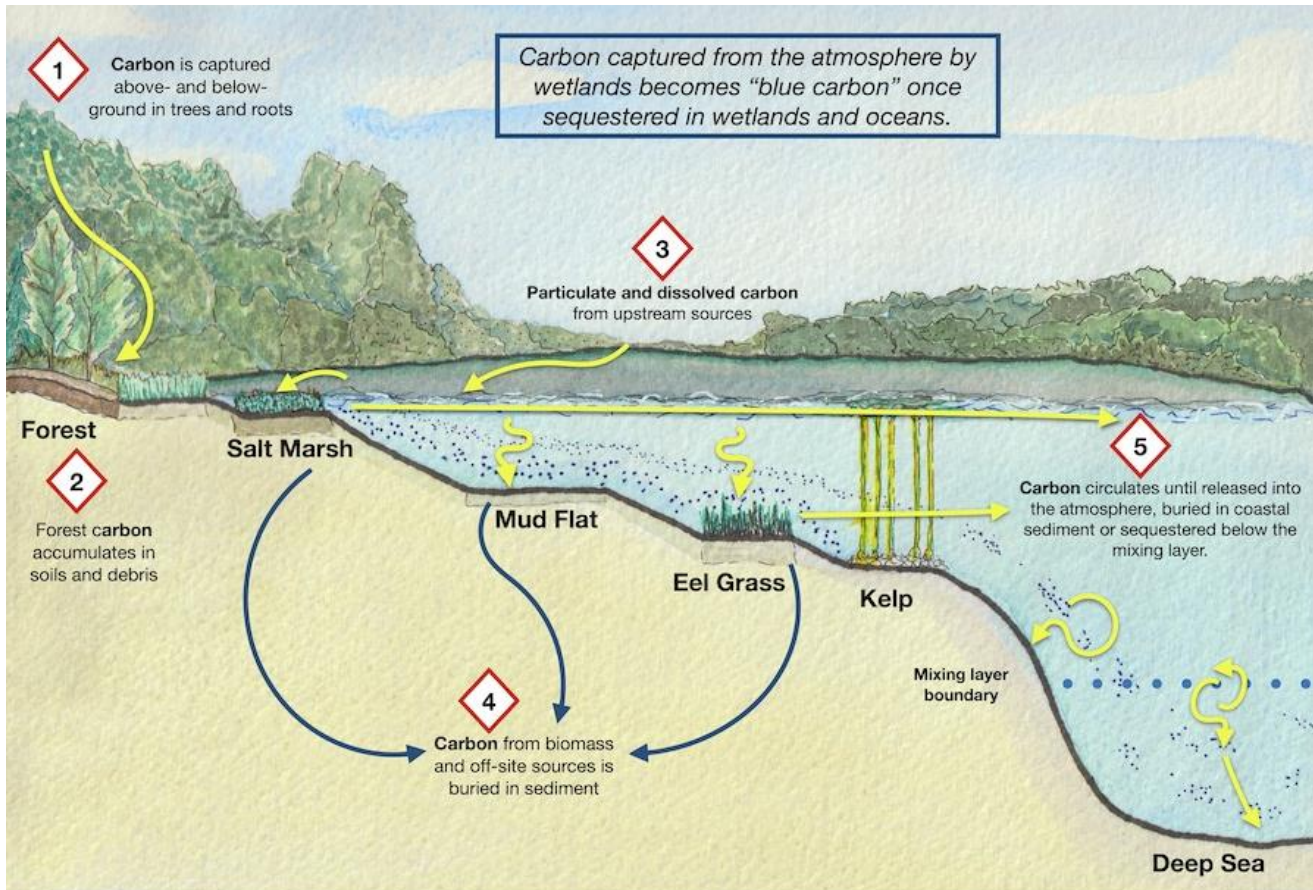
We also know that wetlands provide another vital service — sequestering and storing carbon from the atmosphere — and therefore are an essential piece of the solution to global climate change.

“Blue carbon” is simply a term for carbon dioxide that is captured from the atmosphere by the world’s ocean and coastal ecosystems and stored in the form of biomass and sediments. We now know that human activities give off carbon dioxide, which is a **greenhouse gas** once it enters the atmosphere. The good news is that our oceans and coastal wetlands provide a natural way of reducing the impact of these gases on our climate through *sequestration* (or capturing) of this carbon.

Sea grasses, mud flats, kelp, and tidal marshes along our coast capture and hold carbon, acting as a *carbon sink*. These coastal systems, though much smaller in size, sequester this carbon at a much faster rate than rain forests, and can continue to do so for millions of years. Most of the carbon taken up by these ecosystems is stored below ground where we can't see it, but it is still there locked safely away.

**What is a “greenhouse gas”?**

Our atmosphere contains so-called “greenhouse” gases - carbon dioxide, methane (natural gas), nitrous oxide and ozone. Each acts just like the glass walls of a land-based greenhouse. It lets light and heat in, but it traps and holds the heat. Without any greenhouse gases, it would be freezing on our planet! With just the right amount of greenhouse gases, we are in the “Goldilocks zone” where life has evolved for millions of years. However, when too much carbon dioxide is allowed to escape into the atmosphere, the planet warms, ice caps melt, plant and animal life begins to suffer, and eventually, if left unchecked, life on Earth would be in very big trouble.



Let's talk about the basics of carbon capture.



Referring to the illustration above, the entire process begins in upland forests and other upstream sources. The plants grab carbon from the atmosphere during photosynthesis, and carbon in the water upstream flows downstream.



All those dead leaves, needles, and branches that you walk on during your forest walks are in the process of becoming deep ocean sediments! As trees, shrubs, and animals die, the carbon compounds in their leaves and bodies decompose and return to the earth. There, the rains wash them downhill to rivers and streams, stopping in wetlands along the way.



Eventually, this "recycled" carbon reaches marshes and estuaries, becoming food for other creatures. Over time, this carbon-containing biomass reaches the deep blue sea, where it is held safely away for a very long time.

Consider for a moment how this would be different if the trees in the upland forest had burned instead of living out their natural lives. Instead of being used and reused and stored safely away at the bottom of the sea, the carbon in those trees would have gone directly into the atmosphere. That would add to the greenhouse effect and continue to overheat our planet!



Article #2: US EPA *Functions and Values of Wetlands* Reprinted from <https://www.epa.gov/sites/default/files/2016-02/documents/functionsvaluesofwetlands.pdf>

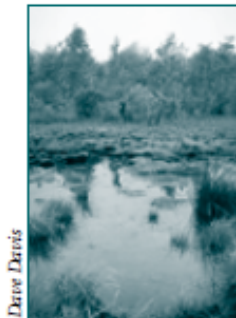
United States  
Environmental Protection  
Agency

Office of Water  
Office of Wetlands,  
Oceans and Watersheds (4502T)

EPA 843-F-01-002c  
September 2001



# Functions and Values of Wetlands



David Dennis

Wetlands are considered valuable because they clean the water, recharge water supplies, reduce flood risks, and provide fish and wildlife habitat. In addition, wetlands provide recreational opportunities, aesthetic benefits, sites for research and education, and commercial fishery benefits.

Long regarded as wastelands, wetlands are now recognized as important features in the landscape that provide numerous beneficial services for people and for fish and wildlife. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods. These beneficial services, considered valuable to societies worldwide, are the result of the inherent and unique natural characteristics of wetlands.



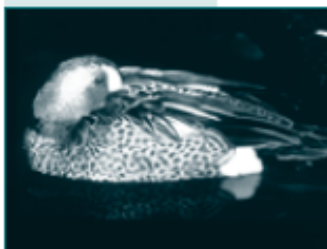
## Functions Versus Values

Wetland functions include water quality improvement, floodwater storage, fish and wildlife habitat, aesthetics, and biological productivity. The value of a wetland is an estimate of the importance or worth of one or more of its functions to society. For example, a value can be determined by the revenue generated from the sale of fish that depend on the wetland, by the tourist dollars associated with the wetland, or by public support for protecting fish and wildlife.

Although large-scale benefits of functions can be valued, determining the value of individual wetlands is difficult because they differ widely and do not all perform the same functions or perform functions equally well. Decision-makers must understand that impacts on wetland functions can eliminate or diminish the values of wetlands.

property damage and loss of life—benefits that have economic value to us. For example, the U.S. Army Corps of Engineers found that protecting wetlands along the Charles River in Boston, Massachusetts, saved \$17 million in potential flood damage.

**Water filtration.** After being slowed by a wetland, water moves around plants, allowing the suspended sediment to drop out and settle to the wetland floor. Nutrients from fertilizer application, manure, leaking septic tanks, and municipal sewage that are dissolved in the water are often absorbed by plant roots and microorganisms in the soil. Other pollutants stick to soil particles. In many cases, this filtration process removes much of the water's nutrient and pollutant load by the time it leaves a wetland. Some types of wetlands are so good at this filtration function that environmental managers construct similar artificial wetlands to treat storm water and wastewater.



**Water storage.** Wetlands function like natural tubs or sponges, storing water and slowly releasing it. This process slows the water's momentum and erosive potential, reduces flood heights, and allows for ground water recharge, which contributes to base flow to surface water systems during dry periods.

Although a small wetland might not store much water, a network of many small wetlands can store an enormous amount of water. The ability of wetlands to store floodwaters reduces the risk of costly



Red-osier dogwood



**Biological productivity.** Wetlands are some of the most biologically productive natural ecosystems in the world, comparable to tropical rain forests and coral reefs in their productivity and the diversity of species they support. Abundant vegetation and shallow water provide diverse habitats for fish and wildlife. Aquatic plant life flourishes in the nutrient-rich environment, and energy converted by the plants is passed up the food chain to fish, waterfowl, and other wildlife and to us as well. This function supports valuable commercial fish and shellfish industries.



The Great Flood of 1993 in the upper Mississippi River Basin caused billions of dollars in property damage and resulted in 38 deaths. Historically, 20 million acres of wetlands in this area had been drained or filled, mostly for agricultural purposes. If the wetlands had been preserved rather than drained, much property damage and crop loss could have been avoided.

### DID YOU KNOW?

- In 1991 wetland-related ecotourism activities such as hunting, fishing, bird-watching, and photography added approximately \$59 billion to the national economy.
- According to the Pacific Coast Federation of Fishermen's Associations, almost \$79 billion per year is generated from wetland-dependent species, or about 71 percent of the nation's entire \$111 billion commercial and recreational fishing industry in 1997.
- An acre of wetland can store 1–1.5 million gallons of floodwater.
- Up to one-half of North American bird species nest or feed in wetlands.
- Although wetlands keep only about 5 percent of the land surface in the conterminous United States, they are home to 31 percent of our plant species.



Steve Delaney

Seventy-five percent of commercially harvested fish are wetland-dependent. Add shellfish species and that number jumps to 95 percent.



**Infographic #1: Coastal Blue Carbon**

Reprinted from <https://www.earthcorps.org/key-initiatives/blue-carbon/>

# COASTAL BLUE CARBON

An investment in wetland restoration supports many important benefits, including *carbon capture*, improved water quality, critical marine habitat, and increased resiliency through storm and flood protection.

**Healthy coastal wetlands BUILD UP SOIL**  
by taking up carbon and storing it in plants and in the ground.

**BLUE CARBON**  
is the ability of tidal wetland and sea grass habitats to capture and store CO<sub>2</sub> and other greenhouse gases from the atmosphere.

**Coastal wetlands...**

- Globally store **84-233M TONS** of carbon every year
- Bury carbon in the ground at rates **10x GREATER** than forests
- Capture carbon at rates **2-4x GREATER** than forests on a per area basis

**The U.S. is losing coastal wetlands faster than we are restoring them.**

- The U.S. lost **80,000 ACRES** of coastal wetlands per year between 2004 and 2009
- Losing **2.5 ACRES** of coastal wetlands releases the same amount of carbon as
- Losing **25-100 ACRES** of native forest

**If the entire Snohomish Estuary in Puget Sound, WA is restored...**

- 8.9M TONS** of CO<sub>2</sub> will be captured over the next 100 years
- offsetting **900M** gallons of gas
- or **1.7M** cars for a year
- or **860,000** homes for a year

**BLUECARBON.US**

Wetland restoration offers a place-based approach to addressing rising atmospheric carbon levels while also providing many benefits for fish, wildlife and the local community.





Task: **Blue Carbon & Wetlands (Grades 9-12)**



**Research Questions for Part 1**

Use your remaining time to answer the questions below. Your answers to these questions will be scored. Also, they will help you think about the sources you have read and viewed, which will help you prepare for your speech. You may refer to the sources and notes when it would be helpful. Answer the questions in the spaces provided below them using information from the sources.

- 1. **Question 1.** Describe three ways wetlands benefit people? Be sure to name your sources. *(Claim 4, Target 2)*

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Task: **Blue Carbon & Wetlands (Grades 9-12)**



2. **Question 2.** Which source is best for learning about blue carbon? Consider both videos, articles, and the infographic. Explain your answer using evidence from the sources. (*Claim 4, Target 3*)

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Task: **Blue Carbon & Wetlands (Grades 9-12)**



3. **Question 3.** Explain wetlands abilities to mitigate or allow people to adapt to a changing climate. Use information from the readings and video in your answer. Be sure to cite your sources. (*Claim 4, Target 4*)

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## **PART 2: Field Investigation**

Arrange for students to visit a coastal wetland. If possible, invite career professionals related to the wetlands, such as wetlands specialists, shoreline planners, etc.

If not possible to visit a wetland, have students take a virtual tour. For example, Great Lakes Now Virtual Field Trip <https://www.youtube.com/watch?v=tX-OvA22MAI>

### **Post-visit Questions for Discussion:**

1. What observations supported the information from the video and articles?
2. What additional information did you gain from visiting a real coastal wetland?
3. What pictures did you decide to take and why?
4. What do you think are the most important benefits of the wetlands you visited?



Task: **Blue Carbon & Wetlands (Grades 9-12)**



**Student Directions:** Record observations. Take pictures that you might use to support your presentation to the city council.

Characteristic	My Observations
<b>Land and Water</b>	
<b>Plants</b>	
<b>Animals</b>	
<b>Human Use and Impact</b>	



### **PART 3: SPEECH**

#### **Student Directions:**

You will now have time to compose and deliver your speech. While you may use your notes and refer to your sources, you must work on your own. You may use your notes from the sources and your data from the field experience. You may also refer to the sources. Read your assignment and the information about how your speech will be scored, then begin your work.

#### **Your Assignment:**

Your city council is researching the benefits of restoring a portion of the shoreline to its original salt marsh. You have the opportunity to speak at the next city council meeting. You will prepare your speech by watching videos, reading articles, and viewing an infographic to build your understanding of this topic. You will also be able to visit a coastal wetland, either live or virtually. Then you will answer several research questions and prepare what you will say at the next city council meeting.

#### **How your speech will be scored:**

*Your speech will be scored on the following criteria:*

- 1. Focus-** How well your speech clearly introduces and communicates your ideas.
- 2. Organization-** How well the ideas flow from the opening to the conclusion and how well you stay on topic throughout the speech.
- 3. Elaboration of Evidence-** How well you use sources, facts, pictures, and details as evidence.
- 4. Language and Vocabulary-** How well you effectively express ideas using precise language that is appropriate for your audience and purpose.
- 5. Presentation-** How well your speech is presented, including eye contact, pronunciation, and awareness of audience and the use of visual/graphics/audio enhancements appropriate to your message.

#### **Now begin work on your speech.**

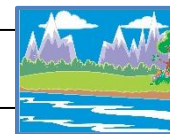
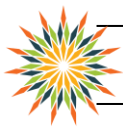
Manage your time carefully so that you can:

1. Review your notes and data
2. Plan your speech using evidence to support your ideas
3. Write your speech
4. Edit and revise your speech



**SPEECH PLANNING TOOL**

<b>Speech Components</b>
Introduction: Capture the audience's attention.
How do wetlands benefit people?
How do wetlands benefit the environment?
How can wetlands mitigate climate change?
Closing:



### SCORING VERSION

4 – Point Speech Rubric (Grades 3-11)				
Score	4	3	2	1
<b>Focus</b>	The speech is consistently and purposefully focused: <ul style="list-style-type: none"> <li>controlling idea, opinion, or claim is clearly stated and strongly maintained</li> <li>controlling idea, opinion or claim is introduced and communicated clearly within the context</li> </ul>	The speech is adequately and generally focused: <ul style="list-style-type: none"> <li>controlling idea, opinion, or claim is clear and for the most part maintained though some loosely related material may be present</li> <li>some context for the controlling idea, opinion, or claim</li> </ul>	The speech is somewhat unclear and unfocused: <ul style="list-style-type: none"> <li>controlling idea, opinion, or claim is for the most part maintained though there may be a minor drift</li> <li>controlling idea, opinion, or claim may be lacking an appropriate context</li> </ul>	The speech is unclear and unfocused: <ul style="list-style-type: none"> <li>controlling idea, opinion, or claim may have a major drift</li> <li>controlling idea, opinion, or claim may be confusing or ambiguous</li> </ul>
<b>Organization</b>	The speech has a clear and effective organizational structure helping create unity and completeness: <ul style="list-style-type: none"> <li>employs a strong opening and logical progression of ideas</li> <li>effective introduction and conclusion for audience and purpose</li> </ul>	The speech has an evident organizational structure and a sense of completeness, though some ideas may be loosely connected: <ul style="list-style-type: none"> <li>adequate use of transitional strategies with some variety</li> <li>ideas progress from beginning to end</li> <li>introduction and conclusion are adequate</li> <li>adequate, if slightly inconsistent, connection among ideas</li> </ul>	The speech has an inconsistent organizational structure: <ul style="list-style-type: none"> <li>inconsistent use of transitional strategies with little variety</li> <li>ideas progress unevenly from beginning to end</li> <li>introduction and conclusion, if present, any be weak</li> <li>weak connection among ideas</li> </ul>	The speech has little or no discernible organizational structure: <ul style="list-style-type: none"> <li>few or no transitional strategies are evident</li> <li>frequent extraneous ideas may intrude</li> </ul>
<b>Elaboration of Evidence</b>	The speech provided thorough and convincing support/evidence for the writer’s controlling idea, opinion, or claim that includes the effective use of sources, facts, and details: <ul style="list-style-type: none"> <li>use of evidence from sources is smoothly integrated</li> </ul>	The speech provides adequate support/evidence for the writer’s controlling idea, opinion, or claim that includes the use of sources, facts, and details: <ul style="list-style-type: none"> <li>some evidence from sources is smoothly integrated though may be general or imprecise</li> </ul>	The response provides uneven, cursory support/evidence for the writer’s controlling idea, opinion, or claim that includes partial or superficial use of sources, facts, and details: <ul style="list-style-type: none"> <li>evidence from sources is weakly integrated</li> </ul>	The speech provides minimal support/evidence for the writer’s controlling idea, opinion, or claim that includes little or no use of sources, facts, or details: <ul style="list-style-type: none"> <li>use of evidence from the source material is minimal, absent, in error, or irrelevant</li> </ul>
<b>Language and Vocabulary</b>	The speech clearly and effectively expresses ideas: <ul style="list-style-type: none"> <li>use of precise language (including academic and domain-specific language)</li> <li>consistent use of syntax and discourse appropriate to the audience and purpose</li> </ul>	The speech adequately expresses ideas employing a mix of precise with more general language: <ul style="list-style-type: none"> <li>use of use of academic and domain-specific language is adequate</li> <li>use of syntax and discourse generally appropriate to the audience and purpose</li> </ul>	The speech inconsistently expresses ideas employing simplistic language: <ul style="list-style-type: none"> <li>use of domain-specific insufficient use of academic and domain-specific language</li> <li>use of syntax and discourse may at times be inappropriate to the audience and purpose</li> </ul>	The speech expresses vague ideas, lacks clarity, or is confusing: <ul style="list-style-type: none"> <li>uses limited language or domain-specific vocabulary</li> <li>rudimentary use of syntax and discourse inappropriate for the audience and purpose</li> </ul>
<b>Presentation</b>	The speech is clearly and smoothly presented: <ul style="list-style-type: none"> <li>use of effective eye contact and volume with clear pronunciation</li> <li>understandable pace adapted to the audience</li> <li>consistently aware of audience’s engagement</li> <li>use of strong visual/ graphics/ audio enhancement, when appropriate, to effectively clarify message.</li> </ul>	The speech is adequately presented with minor flaws:: <ul style="list-style-type: none"> <li>appropriate use of eye contact volume, and pronunciation</li> <li>generally understandable pace adapted to the audience</li> <li>sufficiently aware of audience’s engagement</li> <li>sufficient use of visual/graphics/audio enhancements, when appropriate, to clarify message</li> </ul>	The speech is unevenly presented with evident flaws: <ul style="list-style-type: none"> <li>inconsistent use of eye contact, volume, and pronunciation</li> <li>pace partially adapted to the audience</li> <li>partially aware of audience’s engagement</li> <li>sufficient use of visual/graphics/ audio enhancement, when appropriate, to clarify message</li> </ul>	The speech is presented with serious flaws that obscure meaning: <ul style="list-style-type: none"> <li>infrequent eye contact, and inappropriate volume and pronunciation</li> <li>pace not adapted to the audience</li> <li>little or no sense of audience’s engagement</li> </ul>

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