Science Assessment System Through Course Task

Locating the Lighthouse

Grade Level:
4

Phenomena:
Coastal Erosion

Science & Engineering Practices:
Asking Questions and Defining Problems
Analyzing and Interpreting Data

Crosscutting Concepts:
Cause and Effect

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.

Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations.
   Success criteria include:
   - What is this task designed to get evidence of?
   - What is the task asking the students to do?
   - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
  - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Locating the Lighthouse Task Annotation

After **analyzing and interpreting data from various sources** for *two coastal cities with different geological characteristics*, **develop reasoned questions** that, if investigated, will justify a decision as to the best location* to build a lighthouse where the *impact of erosion will be minimized.*

*Causality is implied: What causes one location to be better than the other? What causes erosion to be faster at one location over another?

Overall intent

The intent of this task is for students to analyze and synthesize information obtained from different sources, then to use the information to develop reasoned questions related to cause and effect relationships about erosion. The answers to the questions that are developed will help others make an informed decision (where to build a new lighthouse).

Phenomenon within the task

This task focuses on the factors that contribute to coastal erosion and the rate of erosion (how fast erosion occurs).

Ideas for setting up the task with students

After you have engaged with this task as a learner, consider the areas of strengths and the needs of your students to determine how you will engage students in the analyzing of the data sources. Regardless of how students engage in task, e.g., whole group, small group, or individually, it is important they are able to access the sources of data in order to understand how each provides different information on factors that cause erosion. Emphasis should be placed on the information that can be gathered from **each** source, then synthesized in order to support the development of reasoned questions. Students will need to consider how the answers to their questions will help the city council members make a wise decision on where to build a new lighthouse.

Intent of the Task for Assessment

The intent of this task is to elicit evidence about a student's ability to: analyze & synthesize information in order to develop questions that can be investigated, and to predict outcomes based on cause & effect relationships.

The students initially have to list the factors that contributed to both lighthouses being moved. This facilitates the students filtering through the data to determine what is most important, as well as finding connections between both accounts (analysis & synthesis). Next, the students theorize why the erosion at the two different sites occurred at different rates. This involves synthesis of the data provided to determine: what factors led to the rate of erosion, and the effects of the erosion on the lighthouse sites. Finally, the students develop questions that can be posed to the city council members to help them determine the optimal site for the lighthouse. This is the culminating event that requires students to synthesize all of the information provided and analyze it in order to develop two questions ***whose answers will lead to a sound lighthouse site decision.***

List components of the task/resources used with the task.

- **A.** Lighthouse task sources for students: a document consisting of all information students will analyze prior to completing the task
- **B.** Lighthouse Scenario and Student Probing Questions: document provides guidance for students/teachers to use as they analyze the pre-task sources
- **C.** Lighthouse Student Task: actual task for student to complete after analyzing the provided sources
- **D.** Lighthouse Teacher Resource: tool for teacher use when reviewing student responses
- **E.** Lighthouse Task Annotation: overview and guidance for teacher use only
- **F.** Lighthouse Pre-task Teacher Guidance: document provides some guiding questions and prompts used by the developing teachers

The task scenario (**Item B**) contains the following sources of information and some thought questions to assist promote making connections between each piece of data.

- Source #1: Class notes on erosion
- Source #2: Interviews with grandparents from each featured city
- Source #3: Pictures of the lighthouses from the two cities
- Source #4: Climate Data (average temperature and precipitation of North and South cities)

The sources can be analyzed one at a time, over multiple days, or as teachers feel appropriate based on ability level. It is essential that students engage in analyzing the sources of information to optimize their engagement in the task. Students should be prompted to make connections between the sources in order to synthesize the data.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. *Gathered in pre-task. (Appendix F)
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (Appendix F)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (Appendix G)

Success Criteria

- Students identify three factors that caused shoreline erosion and compare data from two sources. *Gathered in pre-task
- Students use information synthesized from a variety of sources (provided) to support their reasoning for the cause & effect relationships of weathering and erosion.
- Students generate two relevant investigable questions. Reasoning is provided to justify the cause and effect relationship of each question.

Possible Student Responses

There are many student responses that would be sufficient for this task. Here are some examples:

- What type of soil will the lighthouse be built upon? This is important because the looser, sandy soil erodes much faster than the rocky soil in the two examples.
- How much precipitation does our area receive? This is important because precipitation is a key component of weathering and erosion. More precipitation could cause the shoreline to weather and erode more quickly.
- How much severe weather occurs in the area? This is important because the more hurricanes or floods an area tends to experience, the faster the area will experience weather and erosion.
- What is the temperature range in the area? This is important because the freeze/thaw cycle can break down rock and cause erosion.

Other information teacher teams might find useful when preparing to use this task in the TCT process.

- Teacher should review ALL pre-task material and use all with students.
- Consider partners/teams/whole group when analyzing data.

- Prior to task implantation, students need to have experiences with:
    - various types of questions
    - asking investigable question
    - weathering and erosion before facilitating the task

Extensions and/or other uses after the task is implemented

1. Source #2 provides the opportunity to integrate math practices. For each lighthouse, the date built and date moved are provided (students can determine the age of the lighthouse), the original distance from shore and the distance from shore when moved is provided (students can determine how much of the coastline eroded) and with this information could determine the average rate of erosion each year. Source #4 provides climate data and would be an excellent opportunity to teach the idea of the "average" temperature and precipitation rates.
2. ELA standards can be integrated by having students write a letter to the town council in which they explain their research of the sources. Students can identify what they determine to be three most important factors, cite sources from the sources provided, and ask their questions at the end.
3. The moving of lighthouses actually occurs in cities along the coast. This scenario is loosely based on two actual experiences where communities voted to move lighthouses because of coastal erosion. Students may enjoy researching these stories and learning more about the process of moving a lighthouse. There are many photographs and articles that tell these stories.
4. Students would benefit from learning about human efforts to prevent weathering and erosion, particularly along shorelines.
5. Students would benefit from studying the effects of weathering and erosion in other locations. For example, the National Parks Service spends considerable energy protecting the Statue of Liberty and Mt. Rushmore from the effects of weathering. We see these effects in Kentucky on interstates (rock layers on the sides of the road often have ice and smaller pieces of rock on the ground where gravity has pulled them down), along bodies of water, and in trenches created on soft ground by running water from hard rain. Most schools have some example of weathering/erosion evident from parking lot runoff or in their natural setting. Local examples of weathering/erosion offer the opportunity for problem based learning and the chance to improve drainage problems in their community.

Through Course Task – Locating the Lighthouse

Name _____ Date_____.

Jasmine's coastal town needs to build a lighthouse. This was decided after several boats accidents occurred right off the town's coastal area. The town council was set to hold several town meeting to discuss where to build the new lighthouse.

Jasmine's entire family has always lived along the Atlantic coastline. Both sets of her grandparents actually live in lighthouse towns. One set of grandparents live a few hours north of her town and the other set of grandparents live a few hours south of her town. To her surprise, the lighthouse in both of her grandparent's coastal towns had been moved due the coastline eroding.

Jasmine listened while her grandparents compared bits and pieces about each lighthouse and its history.

One of her grandparents summarized the conversation by stating the following:

The northern lighthouse was originally built closer to the coastline than the Southern lighthouse yet the southern lighthouse had to be moved sooner because of the faster rate of coastal erosion even though the southern lighthouse was 41 years younger than the northern lighthouse.

This confused Jasmine. She wanted to understand how it could be that the lighthouse that was younger and farther from the coastline had to be moved first.

She wanted to know why these lighthouses had to be moved and the questions her town should investigate when selecting a location for their lighthouse. She set out to find sources of information that would help her make sense of all that she had heard.

Jasmine gathered the following five sources of information: 1) class notes on weathering and erosion, 2) a summary of interviews she conducted with her grandparents, 3) pictures of both lighthouses, 4) climate data and 5) severe weather data.

Directions: *Analyze the information in each source (piece of data) to find factors that could have impacted the area around the lighthouse which led to it being relocation. Look for factors that are listed in more than one source and mark similar factors according to the directions after each source. Later, you will develop questions that the town council can investigate to help determine how far to build the lighthouse from the shore.*

See **Source #1: Jasmine's class notes on factors of weathering and erosion**

Review Jasmine's notes on factors that contribute to weathering and erosion. Consider how each of the factors of weathering and erosion found in Jasmine's notes could affect the coast near the lighthouses. Are there some factors that might have a greater impact on coastal erosion than others?

See Source #2: Summary of the interview with Jasmine's grandparents

Create a Venn diagram to help you identify the similarities and differences in the information Jasmine gathered from her grandparents about the northern and southern lighthouse.

Is any of the information shared in the interview also in the class notes? If so, place a #2 next to the information in order to help you identify these pieces of like information.

See Source #3: Picture of the northern and southern lighthouses

Analyze the pictures carefully by looking for factors that contribute to the eroding of the coastal area.

What factors of weathering and erosion can you identify in the pictures that are also in the class notes or in the interview summary? Be sure to mark the similar information with a #3.

See Source #4: Climate data (average seasonal high/low temperatures and average seasonal precipitation)

Analyze the temperature data to determine the answers to the following questions:

- Which of the two cities has a warmer climate?

- Which city has a colder climate?
- ***Do either of the cities get below freezing (on average)?***
- Why is this information important when thinking about weathering and erosion?

Two major forms for precipitation are rain or snow. The form of precipitation depends on the temperature in an area. Analyze the precipitation data to determine the answers to the following questions:

- Which city would experience more rain? N or S
- Which city would experience more snow? N or S
- Which city would experience higher temperatures throughout the seasons? N or S

Put a "#4" by information in the other sources that connects with the climate data you analyzed.

See Source #5: Severe Weather Data

Review the severe weather data and think about the effects of each type of severe weather.

In which city would you predict experiences more that weathering and erosion as a result of severe weather?

O A. northern city
O B. southern city

Explain your thinking?

What other sources include information about severe weather? Mark any similar information you find with a #5.

Through Course Task – Locating the Lighthouse

Name_____ Date_____

Jasmine learned a great deal about the two cities where her grandparents live and about factors that caused the coastline near the lighthouses to weather and erode. Jasmine learned that anytime you addressed the town council, it is necessary to have multiple pieces of data to support each question asked of them. Jasmine reviewed all of her sources. She realized that she did have multiple sources that provided the same information but in different ways.

To prepare for the town council meeting, Jasmine wants to list the factors she thinks need to be considered before deciding on a location for the new lighthouse. She plans to identify two sources that provide information related to each factor she lists.

Part 1

- In Column A**, identify three main factors** that caused the shoreline to erode near Northern and Southern lighthouses. Write **one** of these factors in each of the three spaces provided in Column A.
- In Column B, **check two sources** that best provide evidence of the factors listed in Column A**.**
- In Column C, **provide reasoning** for how the two sources would support factor/cause of weathering and erosion.

Column A Factors/causes of weathering and erosion	**Column B** Sources	**Column C** How sources support factor/cause of weathering and erosion
1.	_____ Source #1: Class notes on weathering and erosion _____ Source #2: Interview with grandparents _____ Source #3: Pictures of the lighthouses _____ Source #4: Climate Data (average temperature and precipitation) _____ Source #5: Severe weather data	
2.	_____ Source #1: Class notes on weathering and erosion _____ Source #2: Interview with grandparents _____ Source #3: Pictures of the lighthouses _____ Source #4: Climate Data (average temperature and precipitation) _____ Source #5: Severe weather data	
3.	_____ Source #1: Class notes on weathering and erosion _____ Source #2: Interview with grandparents _____ Source #3: Pictures of the lighthouses _____ Source #4: Climate Data (average temperature and precipitation) _____ Source #5: Severe weather data	

Part 2

Develop two investigable questions Jasmine could ask the town council, which if answered, would provide useful information to help them decide on where to build the new lighthouse.

Investigable Question 1:

_____

_____

_____

Reasoning: Looking at the causes/factors of weathering and erosion, how would the question, if answered, affect the placement of the lighthouse?

_____

_____

_____

Investigable Question 2:

_____

_____

_____

Reasoning: Looking at the causes/factors of weathering and erosion, how would the question. if answered, affect the placement of the lighthouse?

_____

_____

_____

Locating the Lighthouse - Pre-task Guidance for Teachers

This resource was developed to provide questions/thinking points that could be used to support students when analyzing the sources associated with the lighthouse task. The questions/thinking points are only suggestions that the developing teachers used when facilitating the initial task (or thought about after they facilitated the task).

Throughout the pre-task, students need to make connections between the sources. Consider asking students how they can mark similar data. The task directions suggest that students record the number of the sources but this is only a suggestions. Students might suggest highlighting like information with a specific color or utilizing various symbols. It is important that this be done as students engage in the pre-task. This information will be used again in the actual lighthouse task.

Source1: Jasmine's Class Notes

This source should be referred to after analyzing all of the other sources. Encourage students to identify where

- Which of the factors occur near the coastline? What makes you think so?
- Are any of the severe weather events more likely to occur off the coast, near the ocean?
- What happens to the earth's surface when a _(a noted factor)_ occurs?
- How does the wind affect weathering and erosion along the coastline?
- Topics for further discussion or additional learning experiences:
    - Freeze thaw cycle – impact on earth's surface
    - Soil composition – solubility
    - Waves- sometimes stronger due to the area path they travel to the shore.
    - Rock types – northern area has more igneous and metamorphic rocks. The southern coast has more sedimentary rocks which are more easily eroded.

Source #2: Information from grandparent interviews

- What is the difference in the areas around the lighthouses?
- Why were the Northern grandparents unable to go to the coast in the winter? How does ice affect the rocks along the coastline?
- One lighthouse was originally built closer to the coastline. What can you infer about the coastline in that area? (200 feet vs. 1,500 feet from the coastline)
- What information presented in this source is also found in the class notes? Is it exactly the same information or do you have to make inferences?(Provide example about severe weather in the south is also found in the class notes)
- Venn diagram – what do both lighthouses have in common based on the information from the interview?

Source #3: Pictures of the lighthouses

- Consider showing these pictures on a smartboard!
- Look for similarities and difference in the pictures. Consider recording student observations on a chart.
- Is the appearance of the lighthouse important when looking for factors that affect the weathering and erosion of the coastline? Why or why not?

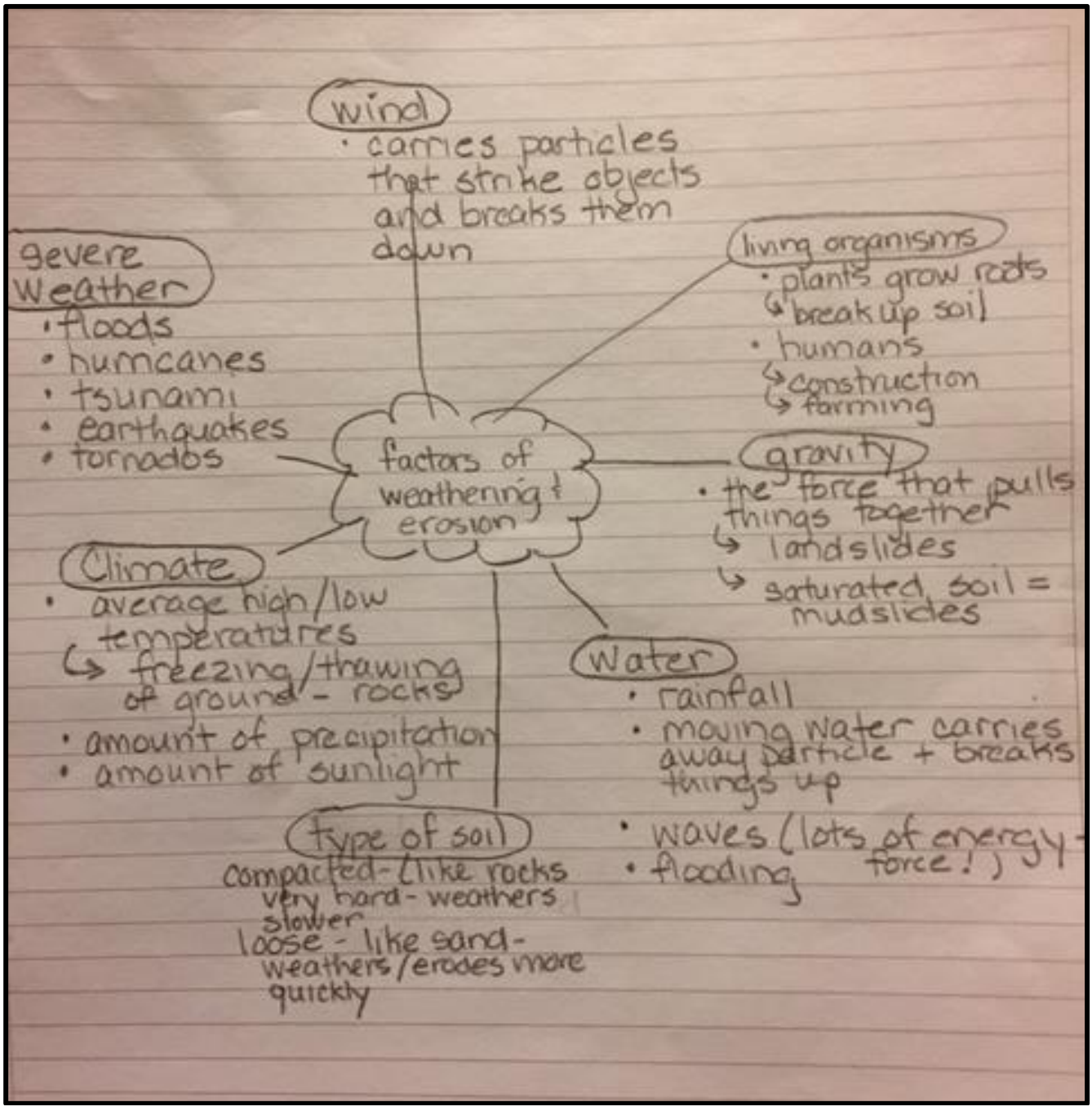
Source #4: Climate data

- Which city experiences more freezing temperatures? How would this affect the earth's surface?
- Consider discussing average temperatures. Just because the average is above freezing doesn't mean that the city will not have any days with temperatures below freezing. (*see additional teacher resource on average winter temperatures- OPTIONAL)
- What city experiences more precipitation? What type of precipitation would you expect for each of the seasons? How can the temperature data help you answer this question?
- What statement could you make about the overall differences in the climate of the two cities?

Source #5: Severe Weather Data

- How do each of the types of severe weather affect the coastline?
- Why would some affect the weathering and erosion of the coastline more than the others?
- Do tornadoes really occur near the coast in the south? (evidence/research extension)

Source 1: Jasmine's Class Notes



Source 2: Notes from Interviews with Grandparents

Northern Lighthouse Interview	Southern Lighthouse Interview
● The lighthouse was built in 1845 on a cliff off the rocky coast of the ocean.	● The lighthouse was built in 1870 on sandy shoreline.
● Coastal rocks are primarily metamorphic and igneous.	● Coastal rocks are primarily sedimentary.
● The lighthouse was originally built 200 feet from shoreline, but was only 40 feet from the shoreline in 2015, when it was moved.	● The lighthouse was originally built 1,500 feet from shoreline, but was only 15 feet from the shoreline in 1999, when it was moved.
● Grandparents remember only being able to go to the shoreline in the summer months because the rocks around the lighthouse were icy in the winter months.	● Grandparents remembered many major storms/hurricanes over the years. They also remember huge waves crashing on the shore.

Source 3: Photographs of Lighthouses

Lighthouse in city **north** of Jasmine

Lighthouse in city **south** of Jasmine

Source 4: Climate Data (Temperature and Precipitation)

Average High/Low Temperatures by Seasons

Degrees in Fahrenheit

Northern City

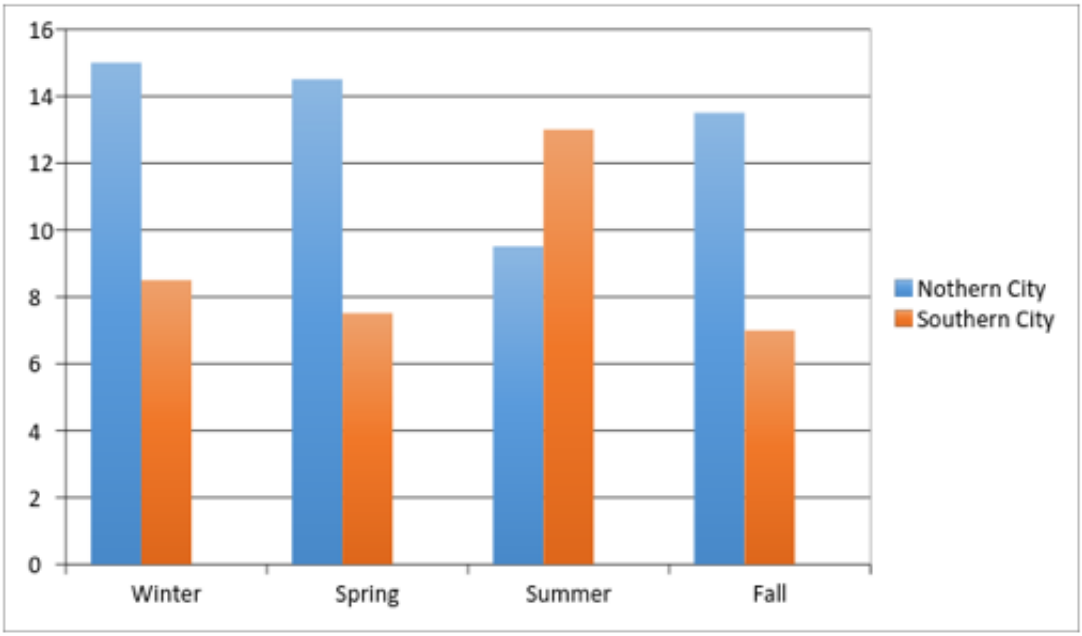
	Winter	Spring	Summer	Fall
High	32	48	67	54
Low	18	22	51	40

Southern City

	Winter	Spring	Summer	Fall
High	54	68	85	75
Low	35	46	68	45

*Water freezes at 32° F and boils at about 212° F.

Average Precipitation (inches per year) of 2 Lighthouse Cities



Source 5: Severe Weather Data

Severe Weather Data for Past 50 Years.

Type of Severe Weather	Number in Northern City	Number in Southern City
Hurricanes	4	16
Floods	5	12
Tornadoes	1	5
Blizzards	10	0