GC1: Your Regional to Global Connection

Purpose

To identify specifically how one's own region is connected with others, and to discover the interconnected nature of the Earth's regions as systems

Overview

Students brainstorm about the nature of connections between their region and others, across oceans and on different continents. On a black-line map of the world, they trace possible pathways of water and wind currents from their part of the continent to other continents, and identify what the wind and water carry. Then they write about the possible effects of activities in other regions on their region, and the possible effects of activities in their regions, on others.

Student Outcomes

Students will be able to,

- trace pathways of wind and water on a world map to and from their region, and across an ocean to other parts of the Earth;
- describe specifically how their region is connected as a system to others across the Earth by identifying what their wind and water carry;
- write about what activities in their region might affect other regions, and what activities in other regions might affect theirs; and
- define *open system* and *closed system*.

Science Concepts

Earth and Space Sciences

Weather changes from day to day and over the seasons.

The sun is the major source of energy at Earth's surface.

Solar insolation drives atmospheric and ocean circulation

Each element moves among different reservoirs (biosphere, lithosphere, atmosphere, hydrosphere).

Physical Sciences

Heat is transferred by conduction, convection and radiation.

Heat moves from warmer to colder objects.

Sun is a major source of energy for changes on the Earth's surface.

Energy is conserved.

Chemical reactions take place in every part of the environment.

Life Sciences

Organisms can only survive in environments where their needs are met.

Earth has many different environments that support different combinations of organisms.

Organisms' functions relate to their environment.

Organisms change the environment in which they live.

Humans can change natural environments.

Plants and animals have life cycles.

Ecosystems demonstrate the complementary nature of structure and function.

All organisms must be able to obtain and use resources while living in a constantly changing environment.

All populations living together and the physical factors with which they interact constitute an ecosystem.

Populations of organisms can be categorized by the function they serve in the ecosystem.

Sunlight is the major source of energy for ecosystems.

The number of animals, plants and microorganisms an ecosystem can support depends on the available resources.

Atoms and molecules cycle among the living and non-living components of the ecosystem.

Scientific Inquiry Abilities

Reading and interpreting maps

Making maps

Develop explanations and predictions using evidence.

Recognize and analyze alternative explanations.

Communicate results and explanations.

Time

One class period

Level

Middle, Secondary

Materials and Tools

Map of study region and surroundings

Map of the world

Maps of major wind and ocean currents, (Figures EA-GC1-2 and EA-GC1-3) provided by GLOBE in the *Teacher's Guide*

Colored pens or pencils for students to distinguish between wind and water on their work sheets

Preparation

Identify a study site.

Make student copies.

-Work Sheets

-Three kinds of maps

Display a variety of maps

Prerequisites

None

Background

Paths of Ocean Currents and Wind Patterns

It is important to understand that the maps provided for identifying ocean currents and wind patterns show average paths over an extended period of time (such as an average of many consecutive Januarys). It is very difficult to trace the exact path of a particular parcel of air or ocean water and anything it might contain. In the atmosphere, the motion of a parcel of air is influenced by a variety of factors, such as its location with respect to the location of the center of low or high pressure, and its altitude. In addition, the motion can be a composite of a lot of different motions. For example, weather patterns (low and high pressure systems), tend to move from west to east in mid-latitudes. However, the air circulates around that center, so that at times an air parcel might be going in exactly the opposite direction from the direction that the system as a whole is moving. The ocean functions the same way. There are major currents, but within those currents there can be eddies which move water in a different way on a smaller scale.

As students of the oceans and atmosphere, we want to look at paths of ocean currents and wind patterns over extended periods of time. For our studies, the span of time should be greater than the life of any single storm system in the atmosphere (about 4-5 days), and longer than the life of an eddy in the ocean (generally longer than a month). In addition, the paths we identify are only approximate, and the actual path may differ considerably from one time period to another. However, these patterns contain important information as to how the Earth system behaves *on average*.

What are Open and Closed Systems?

An open system is one that exchanges material and/or energy across its boundary. A closed system is one that does not exchange any material or energy across its boundary. An almost closed system is one in which there is very little exchange. The Earth system at the global scale is an almost closed system. For Earth system science, the only significant thing that crosses the boundary between Earth and space is energy – incoming energy from the

sun and the thermal radiation (heat) emitted by the Earth into space. All other materials remain for the most part within the Earth system. There is some gas lost to space and some incoming particles but the amount is extremely small.

What to Do and How To Do It

Step 1. Preparation

Identify a study site and region from which students will trace paths of wind and water. If you have not already identified an Earth system study site or a Hydrology study site for this module, the schoolyard itself will suffice.

Make Student Copies

- *Tracing Water Currents and Winds*
- *Global Pathways of Wind and Water*
- Assessment rubric for this activity (You may want to share with students.)

Make student copies of these three kinds of maps:

- Map of study region and surroundings (perhaps several counties or provinces)
- Map of the world
- Maps of major wind and ocean currents, provided by GLOBE

Display where students can see them and any other available maps of the continent and the world.

Obtain any available information about local wind currents and waterways. You may choose to assign this task as a special research project to one or more students. Ask the class to brainstorm about specific ways in which their region is connected to others, across oceans and to different continents.

Step 2. Ask the class to brainstorm specific ways in which their region is connected to others, across oceans, and to different continents.

Distribute copies of the map of the study region and surroundings. Identify and describe the region of study for students. Ask students to use their existing knowledge to suggest what crosses regional boundaries.

If you have conducted *Activity RC1,* students will already be familiar with the region they have identified for Earth system study as a class. If they completed *Activity RC2,* they can recall their work on inputs and outputs of the region as a system.

Student responses may include heat and light, wind and water, and substances and organisms that are carried by wind and water. Encourage students to be specific in their answers. Which bodies of water? Which substances? Which groups of organisms?

Ask students to describe how far and where these components go. Do they leave the state? Do they leave the continent? Do they cross an ocean?

Much of this may be conjecture for students. The more accurate and specific they can be, the better. However, what is most important is for them to begin thinking in terms of specific ways in which their regional system connects with other regional systems. The output of one system becomes the input of another.

Step 3. Review the regional and continental maps with the class, and guide them in tracing the flow of water into their study region, then downstream from their region to connecting regions, and then beyond, to an ocean.

Distribute copies of the *Tracing Water Currents and Winds Work Sheet,* copies of the world maps of average ocean currents and world maps of average winds. See Figure EA-GC1-1 and EA-GC1-2 and copies of your regional and continental maps.

Ask the class to trace the flow of water from their study region. Start upstream at its source, then move downstream through their region to an ocean, noting the names of bodies of water and the regions through which it passes. Note where the water connects on the continental scale.

If students are familiar with the concept of a watershed, and if the region selected for Earth system study is a watershed, this step can be expanded to include students finding their "watershed address." See *Further Investigations.*

Step 4. Have students draw the pathways of their region's air and water on their work sheets: from where it meets an ocean, across that ocean to other continents, to around the globe.

Students may want to use pencil at first; then they can use different colored pens or pencils to distinguish wind direction and water currents from each other.

On their work sheets, they should also write the geographic names of regions along the water's pathway.

Step 5. Review the map of winds with the class, and discuss the paths of wind into and out of their region.

Step 6. Have students draw the pathways of wind on their work sheets, both into and out of the region.

As they did for water pathways, students should write the geographic names of regions through which the wind passes.

Step 7. Discuss the implications of global wind and water circulation patterns for your region.

Conduct a class discussion on the issue. Ask students to consider wind. What are the regions from which wind blows into your region? What might it carry (dust, insects, tiny seeds, particles of soil, smoke, air masses of cooler or warmer temperatures, moisture)? Toward what region does the wind generally blow from your region? What might it carry?

Ask students to consider water. What substances and organisms are carried into and out of your region by water?

Now have students speculate: What activities in other parts of the globe could affect your region? What activities in your region could affect other parts of the globe?

Step 8. Distribute the *Global Pathways of Wind and Water Work Sheet*, **and ask students to complete it, either in class or as homework.**

Student Assessment

The *Global Pathways of Wind and Water Work Sheet* can be used for student assessment. An assessment rubric is provided.

Further Investigations

- **Visit from a Meteorologist**. Ask a meteorologist to speak to the class about regional and global patterns of air and water circulation.
- **Input/Output.** Have students choose one input or output to learn more about, such as volcanic dust, seeds, or insects. They can look into the distribution and/or source of the input or output item they choose, and if it's an animal or plant, they can study its life cycle and its patterns of movement.
- **Your Region's Winds.** Suggest that students discover more details about the circulation of winds in their region. Have them identify the sources of the winds in their region during different times of the year, and draw a map of the region showing wind circulation during the winter months.
- **Connections.** Ask students to pick another region that their Earth system region is connected to, either by a shared boundary or by wind and water currents. Find a GLOBE school there. Monitor that school's GLOBE data for a few weeks, and compare your GLOBE measurement to theirs. How are they the same? Why? How are they different? Why?.
- **Find Your Watershed Address.** (For classes that are familiar with watersheds and have identified a watershed as a region for Earth system study):

  Using maps, the class considers where their study site watershed fits within the larger scale of watersheds – regionally, within their continent, and globally. They then find their "watershed address."

  Distribute copies of the Hydrology study site watershed map to students. Post the other maps where the class can see them. Have students identify the watershed into which their watershed stream flows

by following its course on the map. Name that larger watershed by the name of its largest stream or river. Then ask students to identify the watershed into which that larger watershed stream or river flows, and continue until they have reached the largest possible watershed.

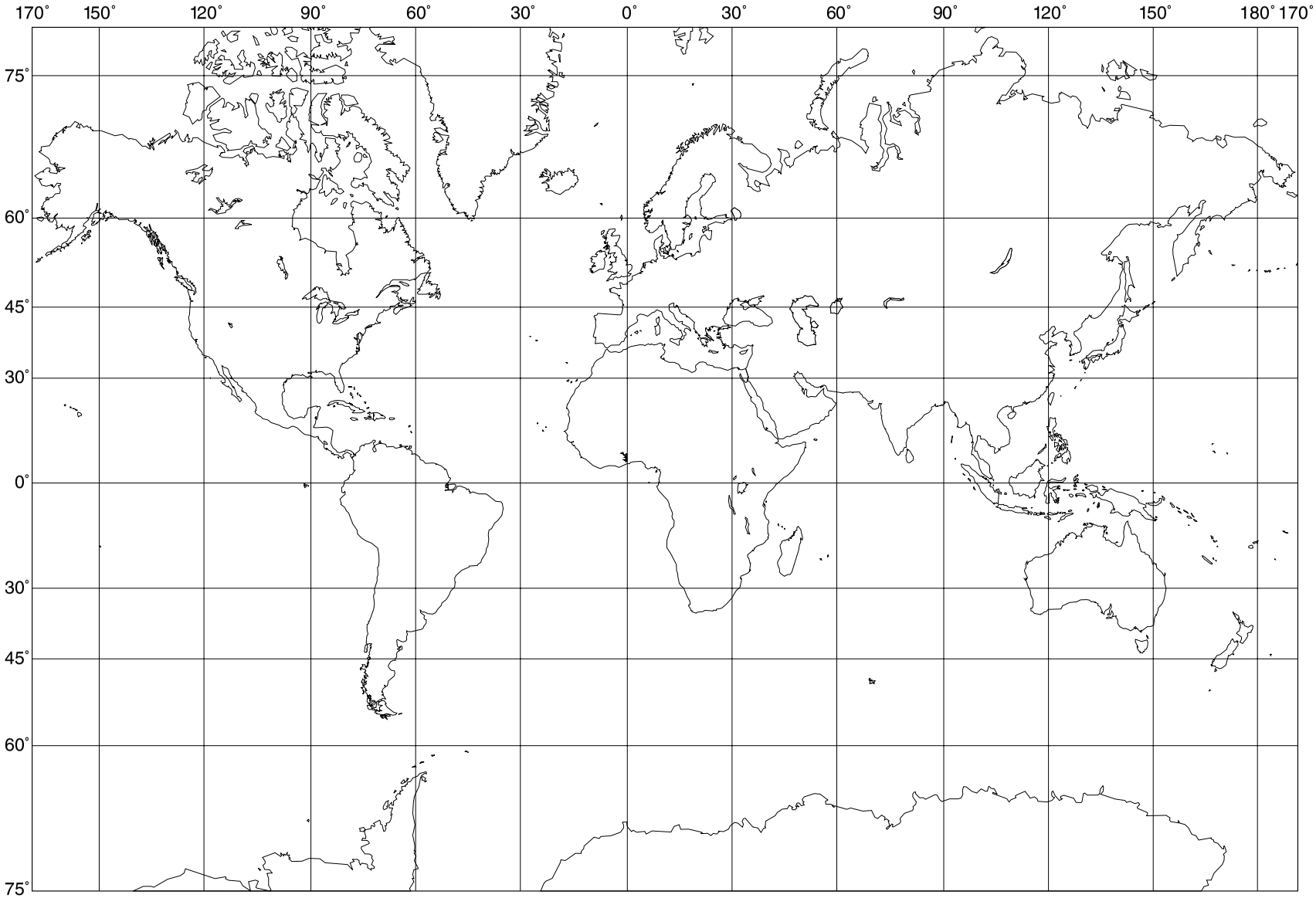
As each larger watershed is identified, have a student volunteer to write the watershed names on the board, drawing arrows from the smaller watershed names to the larger ones. The rest of the students can do this at their desks. When students write those names in the order of the largest watershed to the smallest, they will have their "watershed address."

Sample watershed address:
Atlantic Ocean > Chesapeake Bay > Patuxent River > Western Branch > Folly Branch

Figure EA-GC1-1: Tracing Water Currents and Winds: Black Outline Map of World

Work Sheet-1

Name:_____Class: _____Date:_____



Global Pathways of Wind and Water

Work Sheet-2

Name:_____ Class: _____Date:_____

You have traced pathways of wind and water currents to and from your region.

1. Wind

a. What are the regions from which wind blows into your region? Write down real geographic names (for example, write the name of a mountain chain, not just "mountains").

_____

_____

_____

_____

b. What might the wind be bringing into your region? Think about the places the wind is coming from, what happens there, what lives there. Think about dust, insects, tiny seeds, smoke, air masses of cooler or warmer temperatures, and moisture. Be specific in your responses.

_____

_____

_____

_____

c. When wind blows out of your region, what region does it blow into? Again, write down real geographic names.

_____

_____

_____

_____

d. What might the wind be carrying out of your region? Is it the same as what it brought in? Be as specific as you can about what is being carried, and where it goes.

_____

_____

_____

_____

2. Water

a. What are the regions from which water flows into your region? Write down geographic names.

_____

_____

_____

_____

b. What might the water be bringing into your region? Be as specific as you can.

_____

_____

_____

_____

_____

c.When water flows out of your region, what regions does it flow into? Again, write down geographic names.

_____

_____

_____

_____

d. What might the water be carrying out of your region? Be specific.

_____

_____

_____

_____

3. Pathways That Matter

What events and activities in other parts of the globe could affect your region? Describe events and activities that are caused by people (such as making dams) and those caused by nature (such as volcanic eruptions).

_____

_____

_____

_____

What events and activities in your region could affect others parts of the globe?

_____

_____

_____

4. Open System / Closed System

Earlier in this activity, you identified inputs (what comes in) and outputs (what goes out) for your region as a system. The output of one system can be the input of another system.

Open systems have lots of inputs and outputs, and closed systems do not. Would you say that your region is an open system, or a closed one? Why?

Figure EA-GC1-2: World Map of Average Ocean Currents. Solid lines are warm currents and dashed lines are cold currents.

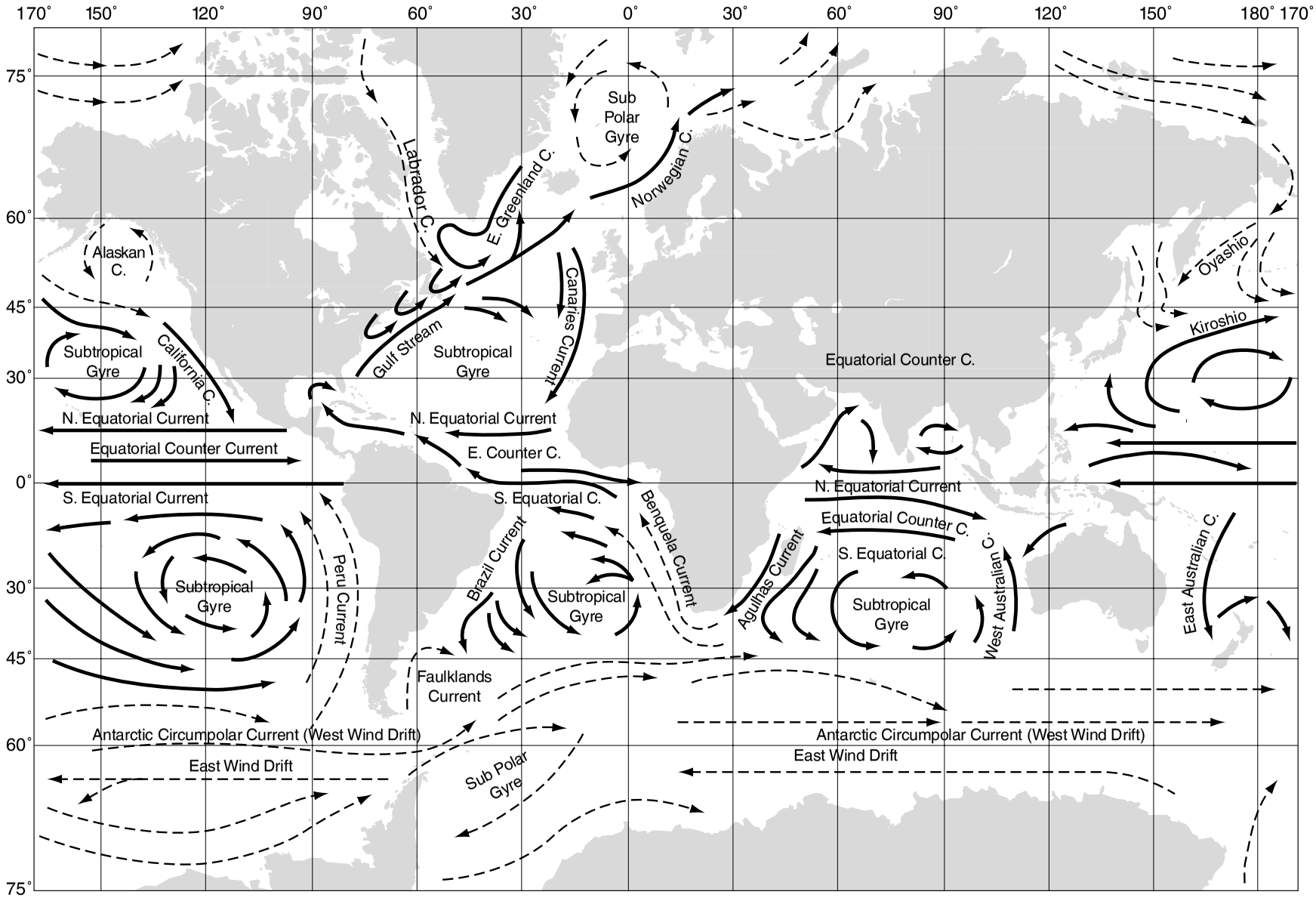


Figure EA-GC1-3a: World Maps of Average Winds in January

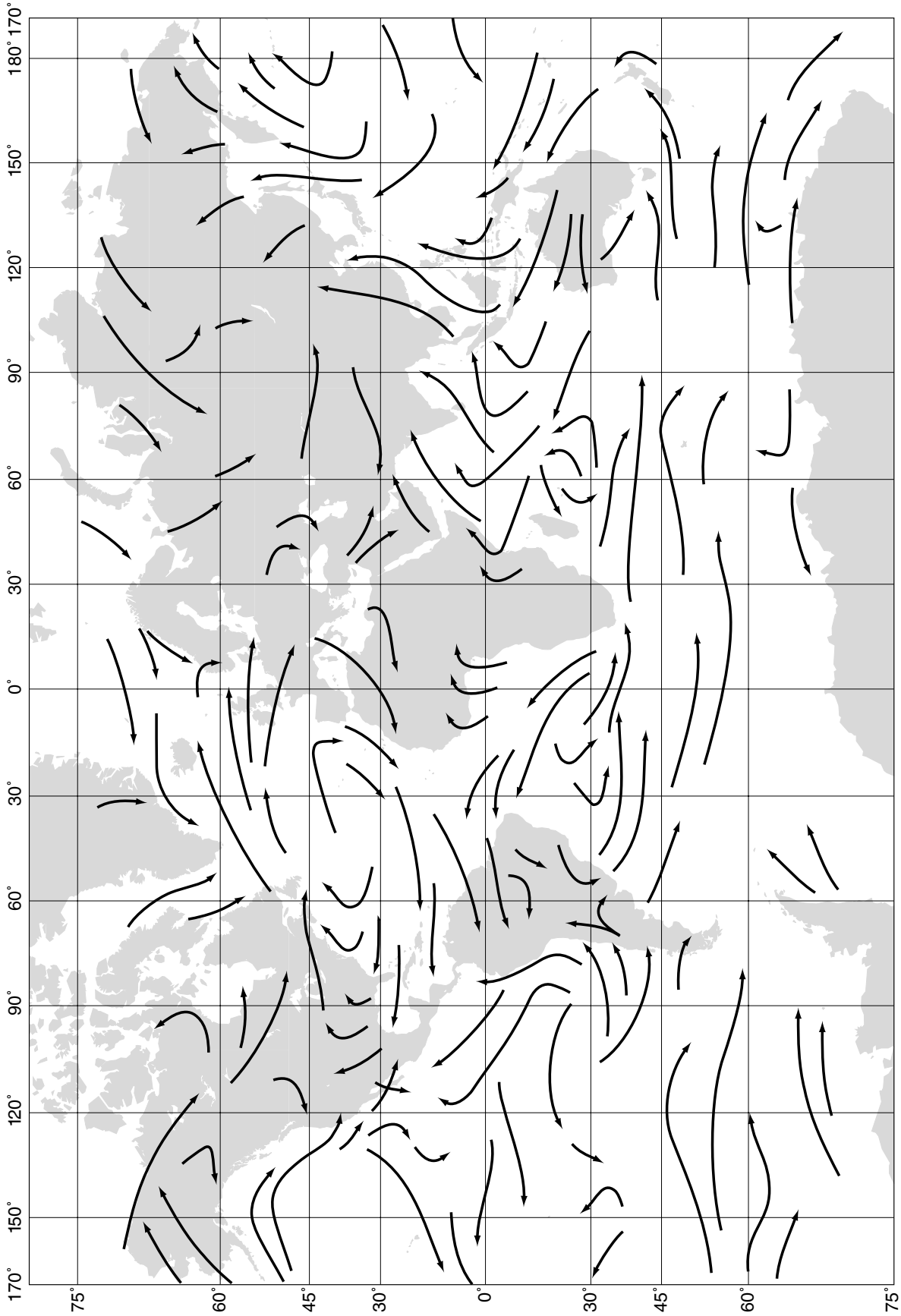


Figure EA-GC1-3b: World Maps of Average Winds in July

Assessment Rubric: GC1: *Your Regional to Global Connection*

Tracing Water Currents and Winds from this Region to Others

	4	3	2	1
Water Pathways accurately	Marks pathways very clearly, completely, and	Marks some pathways clearly and accurately	Marks few pathways clearly and accurately them inaccurately	Has not yet marked pathways, or has marked
Geographic Place Names for Water Pathways	Lists all place names completely and accurately	Lists most place names accurately	Lists some place names accurately	Has not yet listed any place names accurately
Wind Pathways	Marks pathways very clearly, completely, and accurately	Marks some pathways clearly and accurately	Marks few pathways clearly and accurately.	Has not yet marked pathways, or has marked them inaccurately
Geographic Place Names for Wind Pathways	Lists all place names completely and accurately	Lists most place names accurately	Lists some place names accurately	Has not yet listed any place names accurately

Assessment Rubric: GC1: *Your Regional to Global Connection*

Global Pathways to Wind and Water

	4	3	2	1
Wind Connections which wind blows	Accurately names regions from which and to to which wind blows	Accurately names some regions from which and and to which wind blows.	Accurately names 1 or 2 regions from which or to which wind blows	Does not accurately name regions from which
Water Connections	Accurately names regions from which and to which water flows	Accurately names some regions from which and to which water flows	Accurately names 1 or 2 regions from which and to which water flows	Does not accurately name regions from which or to which water flows
Activities That Affect Connected Regions	Thoughtfully and accurately describes several human activities, and events not caused by humans, that affect own region and others. Reflects understanding that regions are interconnected	Accurately describes a few human activities, and events not caused by humans, that affect own region and others. Reflects understanding that regions are interconnected	Describes 1 or 2 human events, and. events not caused by humans, that affect own region and others Reflects minimal understanding that regions are interconnected.	Describes no human activities or events not caused by humans that affect own region or others. Reflects no understanding that regions are interconnected
Region as Open System	Identifies region as an open system, and explains that a lot of substances and living things cross its boundaries	Identifies region as an open system, yet gives unclear explanation why	Identifies region as an open system, yet does not explain why	Does not respond to question, or identifies region as a closed system