Sea Ice: Unscrambling the Egg Code

Levels

III-IV

Grades 5-8

Overview:

Students review their knowledge of the egg code, an international means of describing sea ice, and use their knowledge to interpret Regional Ice Analysis maps. The egg code describes the size of sea ice floes in an area, as well as the thickness, extent and concentration of the ice. It is called the egg code because of its oval shape. (NOTE: This lesson should be completed after “Sea Ice: Cracking the Egg Code” which can be downloaded from the ACMP Web site. Students will need a basic understanding of fractions to complete the lesson successfully.)

Objectives:

The student will:

- determine sea ice thickness, concentration, and floe size by reading egg codes;
- color code a map based on prescribed criteria; and
- use maps to identify changes in sea ice conditions.

GLEs Addressed:

Science

- [5-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations to create inferences and predictions.

Math

- [7] E&C-5 The student accurately solves problems (including real-world situations) involving converting between equivalent fractions, terminating decimals, or percents (10% = 1/10 - 0.1) (M3.3.5)
- [8] E&C-4 The student accurately solves problems (including real-world situations) involving converting between equivalent fractions, decimals, or percents (M3.3.5)

Whole Picture:

Sea ice can be a problem for ships trying to cut a path through cold seas. Large icebreakers can force their way through almost any ice conditions, but even large ships travel easier when captains can find the lightest ice along their route. To make traveling through ice easier, ship captains use ice information produced by government ice experts. This information is in a form known as the “egg code.”

The egg code is a diagram named for its shape. Into different sections of an oval, people who study ice conditions insert numbers that represent local ice conditions. The numbers in the egg code, inserted by people who look at satellite images from above, represent the thickness, type, size, and concentration of the sea ice. Technicians print ice-code ovals on top of ice maps, and captains use the egg code to avoid thick ice and find the best way to get where they’re going. Egg codes are also used for lake ice in large bodies of fresh water

Materials:

- Colored pens or pencils: green, red, and orange (one set per student)
- OVERHEAD: “Cracking the Egg Code”
- OVERHEAD: “January 2006 Regional Ice Analysis”
- OVERHEAD: “September 2005 Regional Ice Analysis”
- STUDENT WORKSHEET: “Unscrambling the Egg Code”

Vocabulary:

trace – a very small amount
egg code – the World Meteorology Organization (WMO) system for describing sea ice
regional – of, relating to, or characteristic of a a broad geographic area <never visited the southwestern region of the U.S.>
concentration – a concentrated mass
floe – a sheet or mass of floating ice

Activity Procedure:

1. Ask students why it is important to know sea ice conditions. If necessary, explain that mariners (sailors) and marine subsistence hunters use sea ice information to determine if it is safe to travel or hunt on the ice. Scientists collect sea ice data to learn more about the environment and investigate trends in sea ice.
2. Display OVERHEAD: "January 2006 Regional Ice Analysis." Explain that maps such as this provide scientists and others with the information they need to navigate and study sea ice.
3. If needed, walk students through the interpretation of the egg code. Display OVERHEAD: "Egg Code." First, point out the top number of the egg. Remind students that this number represents how much of the specified region is covered in ice. The number is expressed in tenths, so if the number were 5, the region would be 5/10 or half covered in sea ice. Since the example number is 8 it tells us that more than eight tenths of that area is covered in sea ice. However, since the number is not 10, we know that not all the water in that area is covered in ice.
4. Next, remind students that the second section from the top is a breakdown of the total ice coverage graded by thickness. The number on the left indicates how much of the sea ice is thickest, the number is the middle indicates how much ice is medium, and the number on the right indicates how much is thinnest. These numbers are also expressed in tenths. Since the second row is a breakdown of the total ice coverage, it should add up to the same number as the first (or top) row. In this case, the thickest ice is five-tenths (one-half) of the total coverage, the medium ice is one-tenth, and the thinnest ice is two-tenths (one-fifth) of the total coverage. (NOTE: If necessary, demonstrate how to reduce and compare fractions.)
5. The third section from the top of the egg code describes the stage of development and thickness, while section four describes the floe size of each section described in the second row. This information is expressed as a number code.
6. Show students how to determine the stage of each thickness of ice by using the stages of sea ice development code. Looking at the example egg code, the thickest ice is listed as stage 7., meaning old ice. The medium ice is listed as 1., meaning medium first-year ice. Ask students what stage of sea ice development the thinnest ice is for the example code. (*New ice*.) Draw students' attention to the middle column of the sea ice development chart which indicates the thickness of each type of ice. This way, a mariner or hunter can determine which ice is thick enough to travel on (via foot or dogsled), or thin enough to travel through (via boat or kayak).
7. The last section of the chart displays the forms of sea ice for each type of ice. Like the stages of sea ice development, the forms of sea ice have a code that can be interpreted using a chart. The example egg code is comprised of medium ice floe (4), big ice floe (5), and new ice (X).
8. Display OVERHEAD: "January 2006 Regional Ice Analysis" again. Point out the egg code labeled EE on the map. Ask students what they can determine about those zones based on the egg code. If needed, explain that the "9 +" in the top section of the egg code represents the fact that those zones are more than nine tenths covered in sea ice, but not completely covered.
9. Point out the regions labeled D on the map and ask students what they can determine about the D regions of ice from the map and the egg code. Explain that all the D regions are against the shore, and walk students through the egg code interpretation. First, draw students' attention to the fact that

the number in the top section of the egg is 10. Remind students that this section of the egg representation how much of that region is covered in ice. In this case, the egg code for region D shows the number 10, meaning that ten tenths of the area is covered in ice. In other words, all the areas of the map labeled D are completely covered with ice.

10. Point out that the second section of the egg labeled D is blank. Ask students what should be in this section. If necessary, remind students that this section can contain up to three numbers. The number to the left denotes the area of the ice that is thickest; the number to the right denotes the area of the ice that is thinnest; and the number in the middle shows the area of ice that is medium. The reason that D does not have any numbers in its second section is that there is only one type of ice in these regions.
11. Attract students' attention to the number outside the D egg, to the left of the third row. Explain that this number represents trace amounts, or very small amounts, of ice. That is, ice that is less than one tenth of the zone. The third row is the stages of sea ice development code. 7 represents first year thin ice, so one can tell from the 7 to the left of the third row that D zones contain trace amounts of first year thin ice.
12. Make sure students understand the egg code and its function.
13. Distribute the STUDENT WORKSHEET: "Unscrambling the Egg Code" and instruct students to complete the worksheet individually or in small groups. Direct students to ignore trace amounts of ice, as listed to the outside of the eggs. Assist as needed.
14. Discuss students' results including student answers to question 8. Make sure that students understand that ice initially forms on the surface of an open ocean. When the air is colder above the ice than the water below (as it is most of the year in Alaska), heat flows from the warm water to the cold air. The initial thin sheet of ice will thicken quickly as the water cools. As the ice thickens, the rate of growth gradually slows until it stops completely.

Critical Thinking Question: Information Processing Method. Display OVERHEAD: "September 2005 Regional Ice Analysis." Ask students to break into small groups to discuss how they interpret the image. Specifically, ask students to examine the stage of ice present around the edge of open water, the concentration of ice in each region, and the floe size in each region. Also, ask students to develop a hypothesis to explain why there is less open water in September than October. Remind students that a hypothesis is an "if, then, because" statement that is testable.

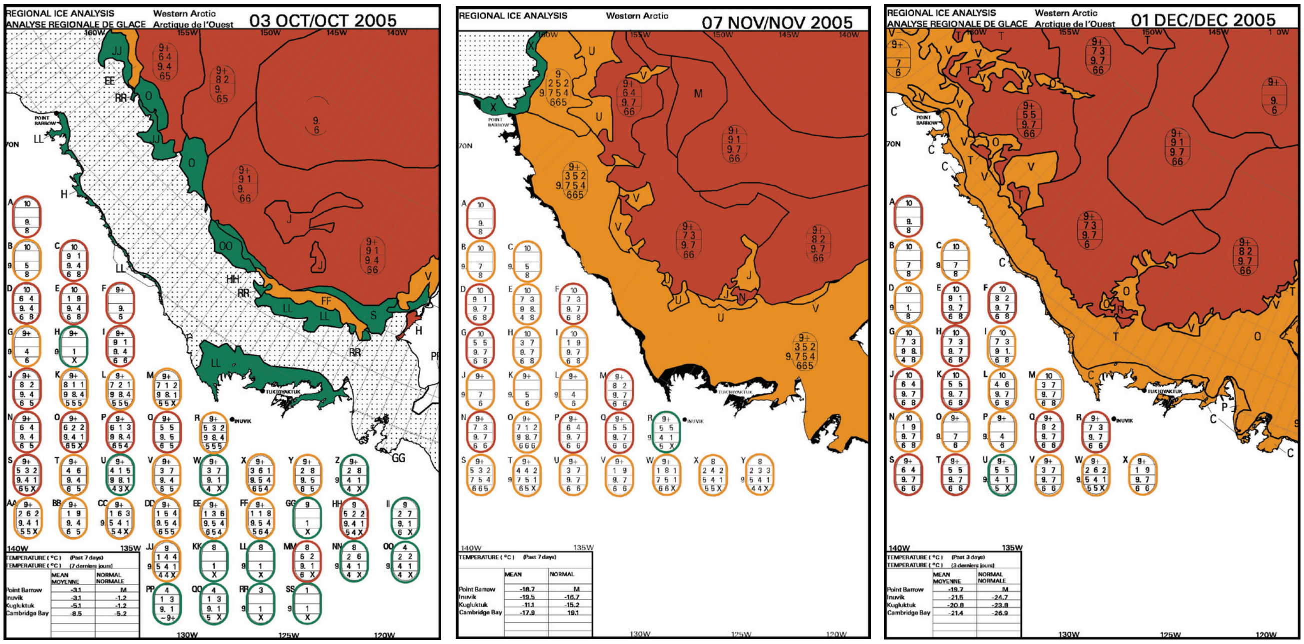
As a class, discuss students' observations, the reason for less open water in September than October, the presence of more regions on the map, and the lack of new ice. If necessary, explain that there is no new (thin) ice because September is the end of a period of warming. New ice that formed over the previous winter has thickened to the point where it is no longer new ice, but first-year ice of varying thicknesses. That ice is now is the process of melting or disintegration. For example, the large region of ice labeled DD (south and to the east of Point Barrow) is of low concentration, and consists mostly of thick first-year ice.

Extension Idea: As a class, discuss students' observations, the reason for less open water in September than October, the presence of more regions on the map, and the lack of new ice. If necessary, explain that there is no new (thin) ice because September is the end of a period of warming. New ice that formed over the previous winter has thickened to the point where it is no longer new ice, but first-year ice of varying thicknesses. That ice is now is the process of melting or disintegration. For example, the large region of ice labeled DD (south and to the east of Point Barrow) is of low concentration, and consists mostly of thick first-year ice.

Answers:

Answers will vary, but should resemble the following:

1.



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2. D. At the edge of open water
3. Answers will vary, but should include that the ice forms on open water, where the air is coolest.
4. Answer will vary. Possible answers include: less new or thin ice, less open water, more first-year or thicker ice, and larger floe size.
5. Answers will vary. Possible answers include: less open water, larger floe size, and less new or thin ice.
6. Answers will vary, but should include the fact that the thinner ice has thickened.
7. A. 22

   B. 5

   C. 2
8. Answers will vary.

Name:___________________________

Unscrambling the Egg Code

Student Worksheet (page 1 of 5)

Levels III-IV

1. Examine the egg codes on each map (See October 2005, November 2005, and December 2005).
    A. Create a color code by doing the following to each map:
        i. Circle or outline in green each egg that contains 50% or more ice less than 10 centimeters thick.
        ii. Circle or outline in red each remaining egg that contains 50% or more ice that is more than 120 centimeters thick.
        iii. Circle or outline in orange each remaining egg that contains 50% or more ice that between 10 centimeters and 120 centimeters thick.
    B. Shade or color the ice floes on the map to correspond with the color code created in step 1A.
    C. Answer the questions below.

2. In the map dated October 2005, where is the thinnest ice?
    A. at the edge of the thickest ice
    B. at the edge of the thinnest ice
    C. at the edge of land
    D. at the edge of open water

3. Explain why the ice forms where it does?

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4. Describe at least three changes between the October 2005 map and the November 2005 map.

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5. Describe at least three changes between the November 2005 map and the December 2005 map.

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Name:____________________________

Unscrambling the Egg Code

Student Worksheet (page 2 of 5)

6. From November to December 2005, there was a decrease in ice that is between 10 centimeters and 120 centimeters thick. Why did this change occur? What happened to the “missing” ice?

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7. For each month, identify the number of regions that contain new ice:
   A. October ____________________
   B. November ____________________
   C. December ____________________

8. What would you expect the September 2005 map to look like? Why?

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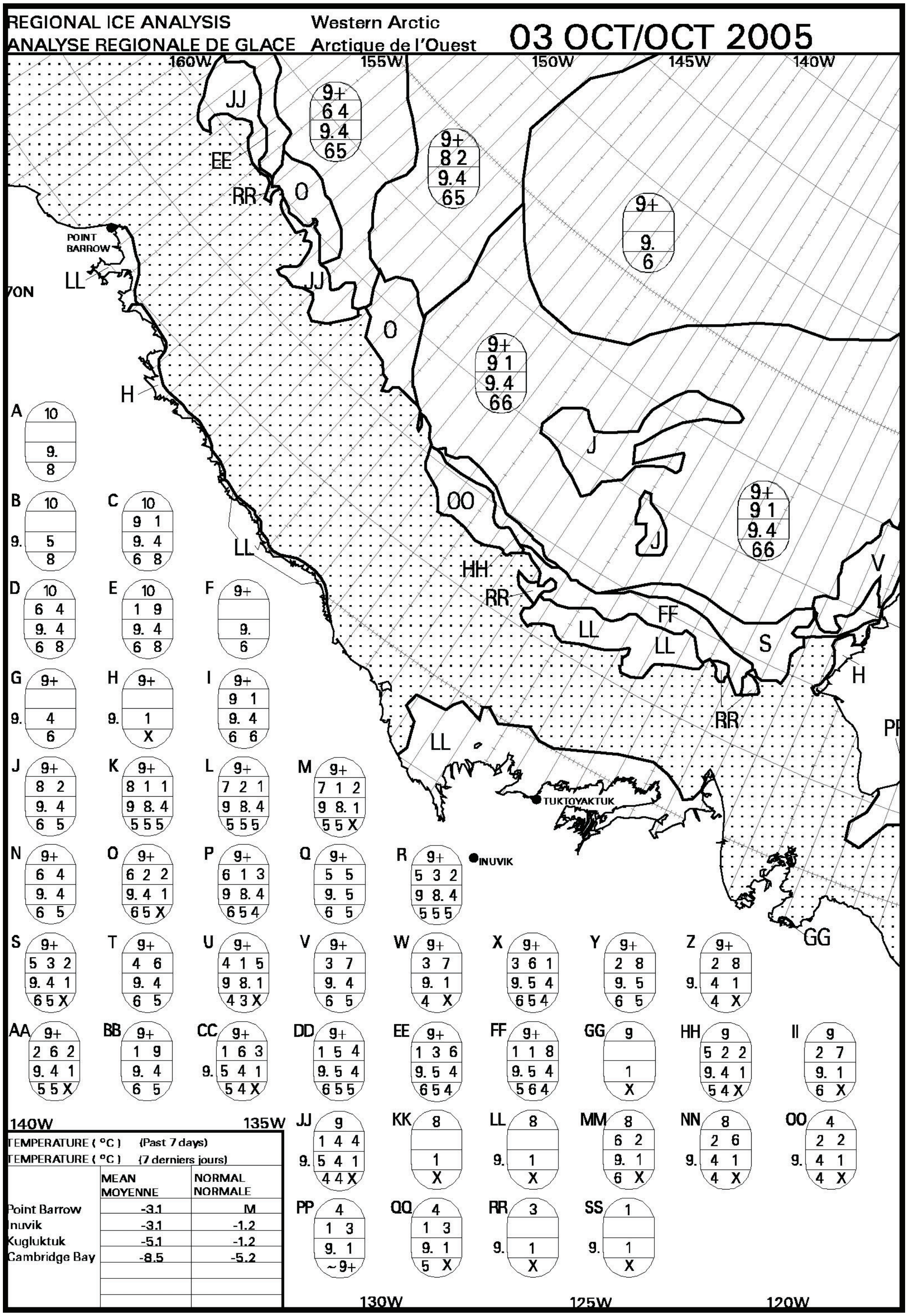
Name:___________________________

Unscrambling the Egg Code

Student Worksheet (page 3 of 5)



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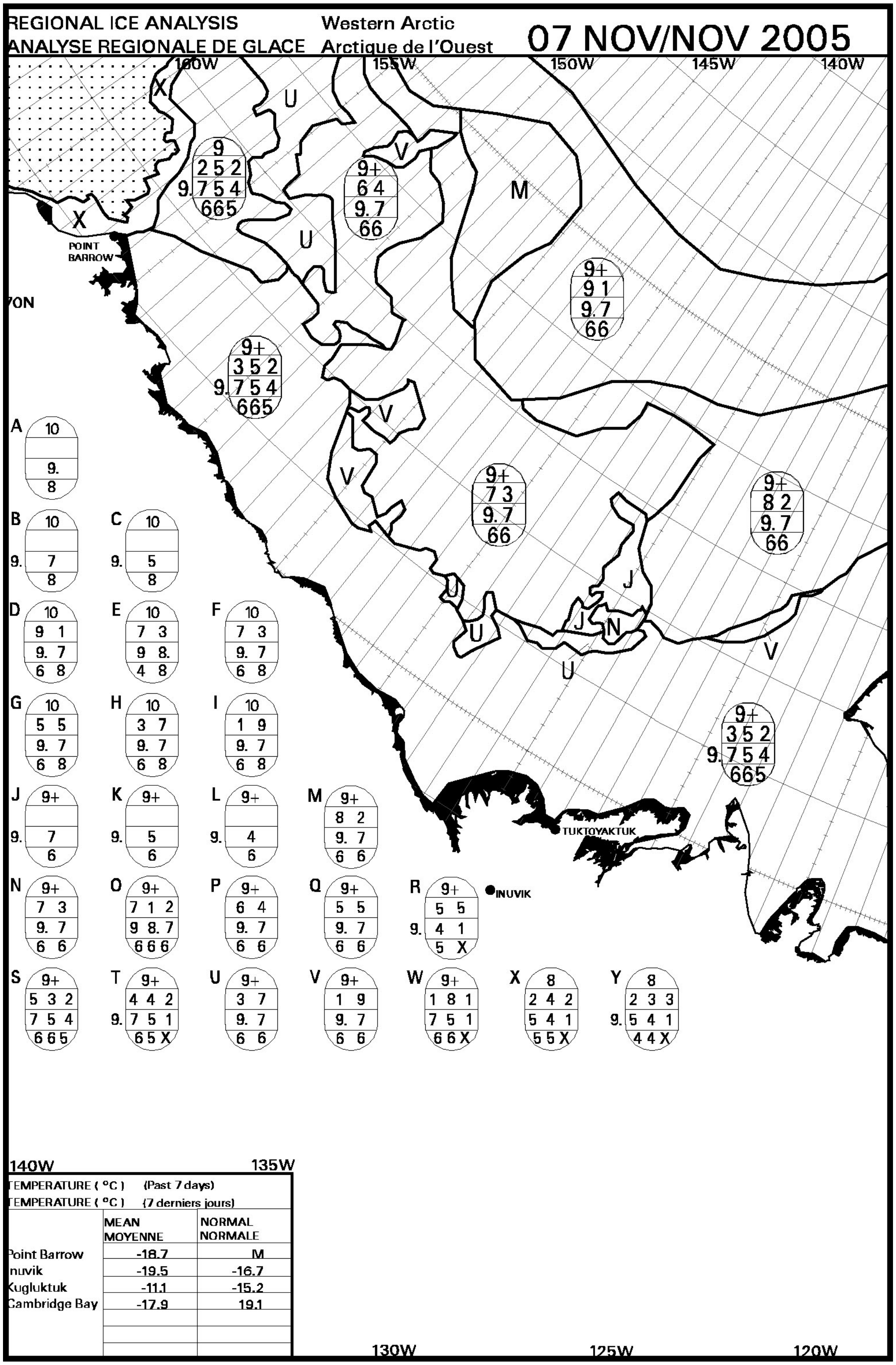
Unscrambling the Egg Code

Student Worksheet (page 4 of 5)



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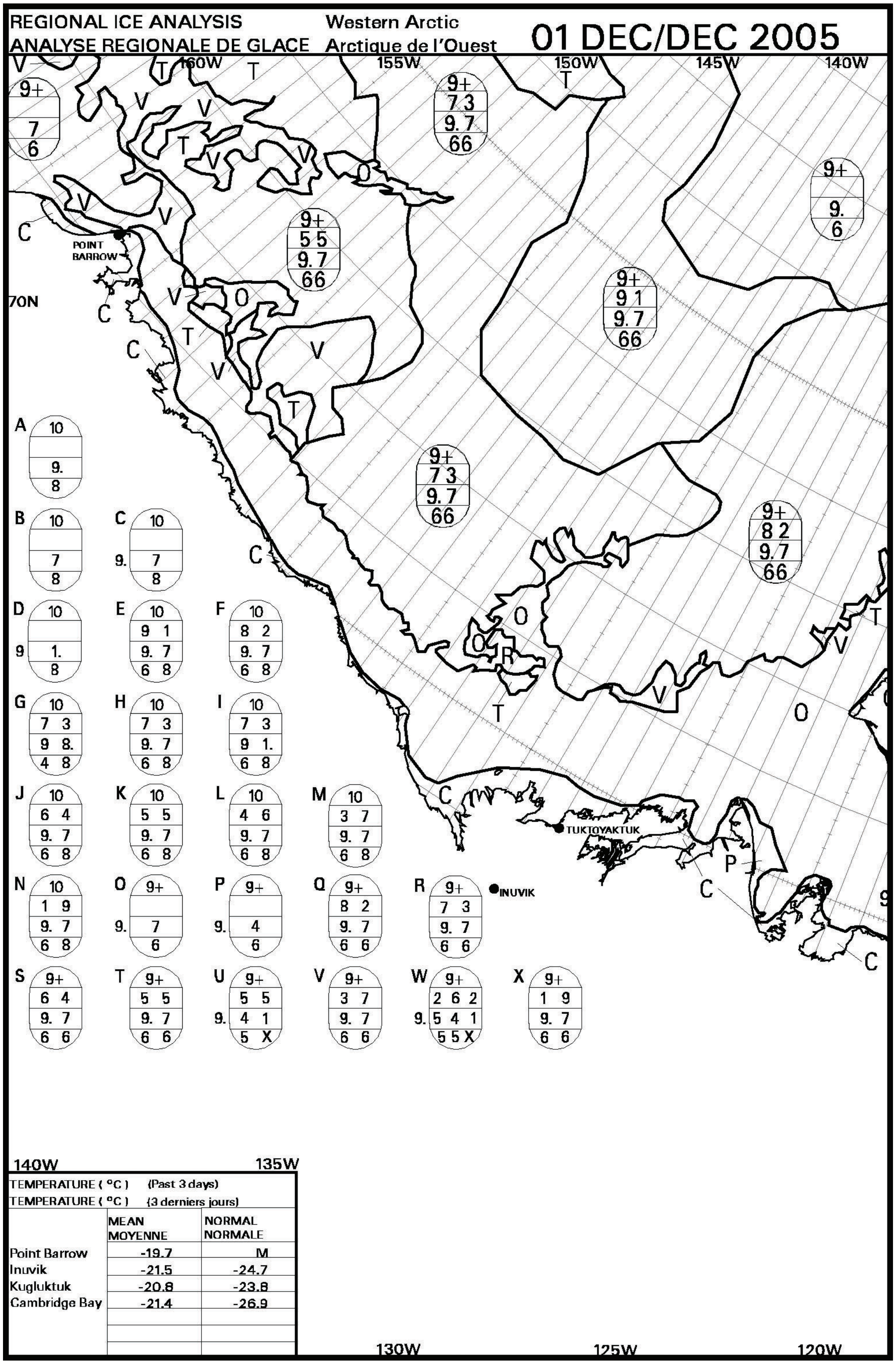
Unscrambling the Egg Code

Student Worksheet (page 5 of 5)



TEMPERATURE (°C) (Past 3 days) / TEMPERATURE (°C) (3 derniers jours)	MEAN MOYENNE	NORMAL NORMALE
Point Barrow	-19.7	M
Inuvik	-21.5	-24.7
Kugluktuk	-20.8	-23.8
Cambridge Bay	-21.4	-26.9

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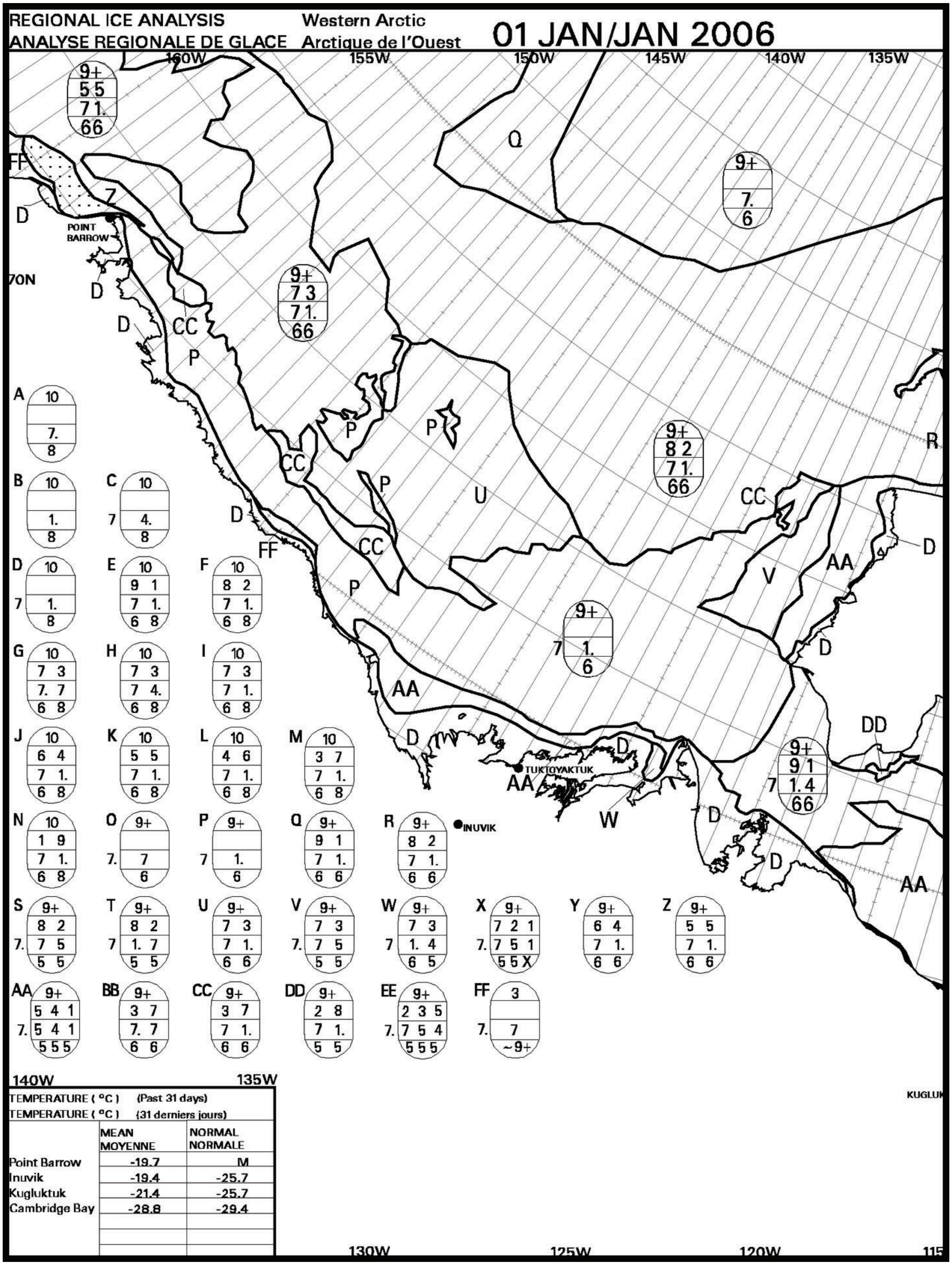
January 2006 Regional Ice Analysis

Overhead



TEMPERATURE (°C) (Past 31 days) / TEMPERATURE (°C) (31 derniers jours)	MEAN MOYENNE	NORMAL NORMALE
Point Barrow	-19.7	M
Inuvik	-19.4	-25.7
Kugluktuk	-21.4	-25.7
Cambridge Bay	-28.8	-29.4

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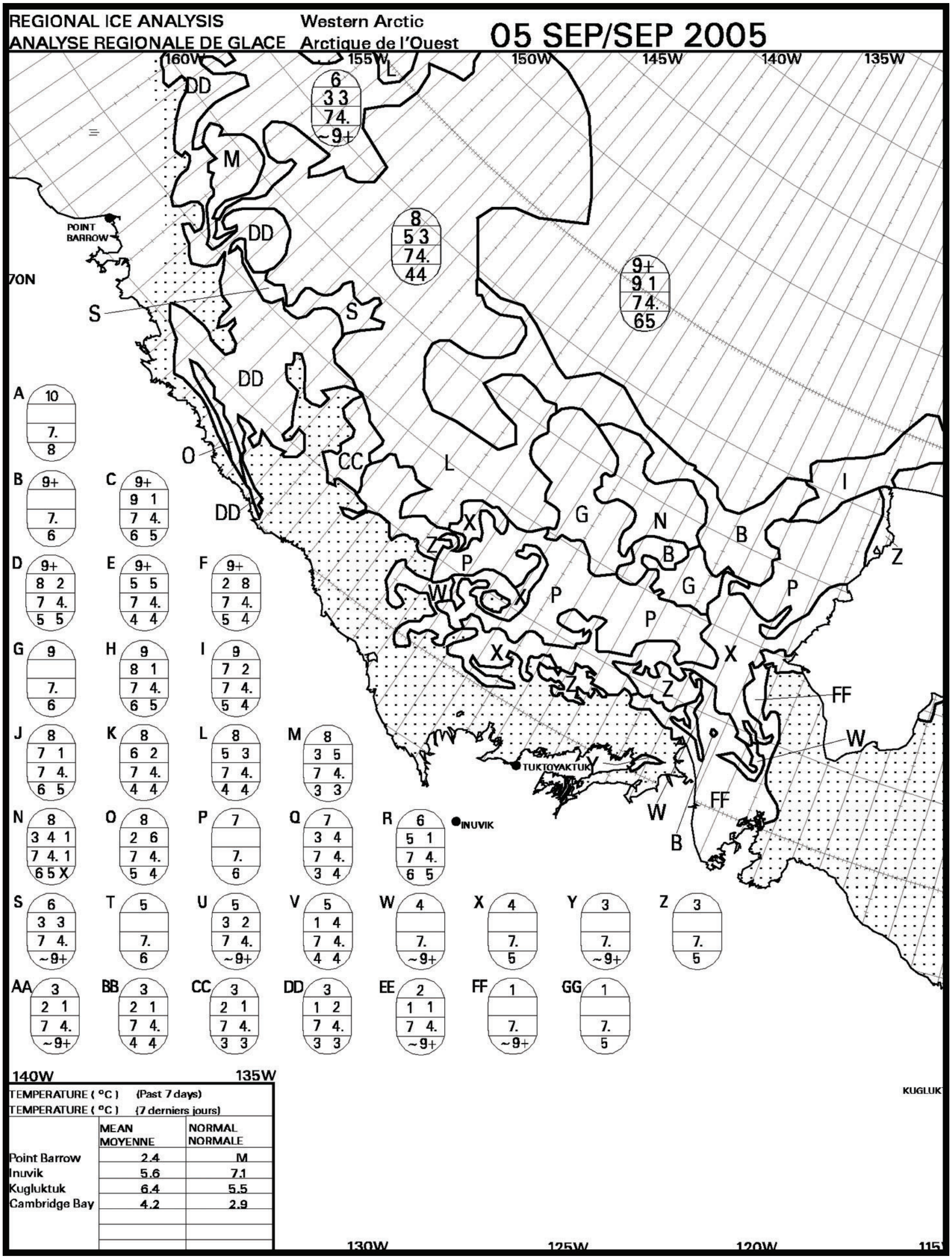
September 2005 Regional Ice Analysis

Overhead



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