

1. Basics Information about the Project	
Aircraft navigation has a range of methods – to the completely visual, to complicated flight management systems. This unit will focus on the two basic methods of navigation used by VFR (Visual Flight Rules) pilots – Pilotage and Dead Reckoning.	
Project Title	Pilotage and Dead Reckoning Navigation
Employer Site	Alpha One Flight Services
Submitted By (teacher's name)	Eric Brunelle
School	Brockton High School
Brief Description and Rationale.	This Unit will be used in our new Aviation program beginning this year. This area is lacking in the curriculum package we will be using and includes many STEM connections.
Grade Level	Grades 9 - 12
Materials/Resources	Plotters, WAC, TAC and Sectional Aeronautical Charts
Duration of lesson	5 lessons at 55 minutes each
Key Vocabulary/Word wall	Pilotage, Dead Reckoning, Course, True North, Magnetic North, magnetic variation, landmarks, charts
Pre-requisite knowledge	8 th grade math skills, use of a ruler
Strategies to promote equity	All students will be provided with the necessary tools – no additional technology.
Instructional Objectives	<ul style="list-style-type: none"> • Students will be able to understand the navigation markings and symbols on a Sectional Chart • Students will understand flight planning techniques using a Sectional Chart • Students will understand the terms <i>Pilotage</i> and <i>Dead Reckoning</i>

(Note: Please attach relevant documents.)

What subject area(s) does this project focus on (check all that apply)?

- ELA
- Mathematics
- Science Technology/Engineering
- Arts
- Technology
- Vocational/Technical (CTE)
- Career Development

When will this project/lesson take place (school year, summer program, after-school program)?

This Unit will take place during the 2020-21 school year

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2 Instructional Techniques

Use this section of the template to describe instructional strategies, drawing from the recommended strategies shown below or other strategies for unit plan or for each lesson plan.

Reading Strategies	Students will explore the VFR Sectional and TAC Chart legends to develop understanding of the various symbols used on these charts.
Multimedia/Visual Strategy (e.g. slides)	The Unit will use PowerPoint presentations, paper charts, plotters and pencils
Graphic organizers or handouts	<p>Lesson 1</p> <ul style="list-style-type: none"> Digital TAC, WAC and Sectional Charts, Chart handouts <p>Lesson 2</p> <ul style="list-style-type: none"> Google Earth Pro, Longitude and Latitude handout <p>Lesson 3</p> <ul style="list-style-type: none"> Magnetic compasses, New York Sectional Charts, #2 pencils, straight edge <p>Lesson 4</p> <ul style="list-style-type: none"> Aviation Plotters, pencils and New York Sectional Charts <p>Lesson 5</p> <ul style="list-style-type: none"> Flight Plan log, Flight Plan Instructions, Aviation Plotters and Sectional Charts
Writing Strategies	Students will reflect on the days or previous days activities in their journals.
Speaking and Listening Strategies	There will be additional lessons in this unit, where presentations to the class will be the culminating activity.
Family: Any opportunities to involve parent/guardians and other family members in this project?	At some point during the school year, we will plan a field trip to the airport. There will be opportunities for parents to meet their children at the airport and experience a discounted “Discovery Flight”. There will also be a “Young Eagles” day at Plymouth Airport where children ages 10-17 can get a free discovery flight with a volunteer pilot. I have participated in both of these activities in the past.
Virtual/Remote Teaching Strategy	This lesson can be done remotely; however it will be missing the individual help and group support. This can be overcome to some extent through the use of online video tutorials, of which there are many.

3 Learning Standards	
Framework	<p>VTE Frameworks</p> <p>4. A.01 Develop a career plan and portfolio</p> <p>4. B.01 Demonstrate appropriate oral and written communication skills in the workplace.</p> <p>4. B.02 Demonstrate active listening skills.</p> <p>4. C.03 Accepts direction and constructive criticism.</p> <p>4. C.06 Interact appropriately with coworkers.</p> <p>Common Core</p> <p>RST.9-10.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.</p> <p>NGSS Standards</p> <p>HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>Science and Engineering Practices</p> <p>Asking Questions and Defining Problems</p> <p>Constructing Explanations and Designing Solutions</p> <p>Disciplinary Core Ideas</p> <p>ETS1.A: Defining and Delimiting Engineering Problems</p> <p>Crosscutting Concepts</p> <p>Systems and System Models</p> <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <p>HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p>Science and Engineering Practices</p> <p>Constructing Explanations and Designing Solutions</p> <p>Disciplinary Core Ideas</p> <p>ETS1.B: Developing Possible Solutions</p> <p>Crosscutting Concepts</p> <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p>
Domain or Strand	2016 Massachusetts Science and Technology/Engineering Curriculum Framework
Grade Level	Grades 9-12

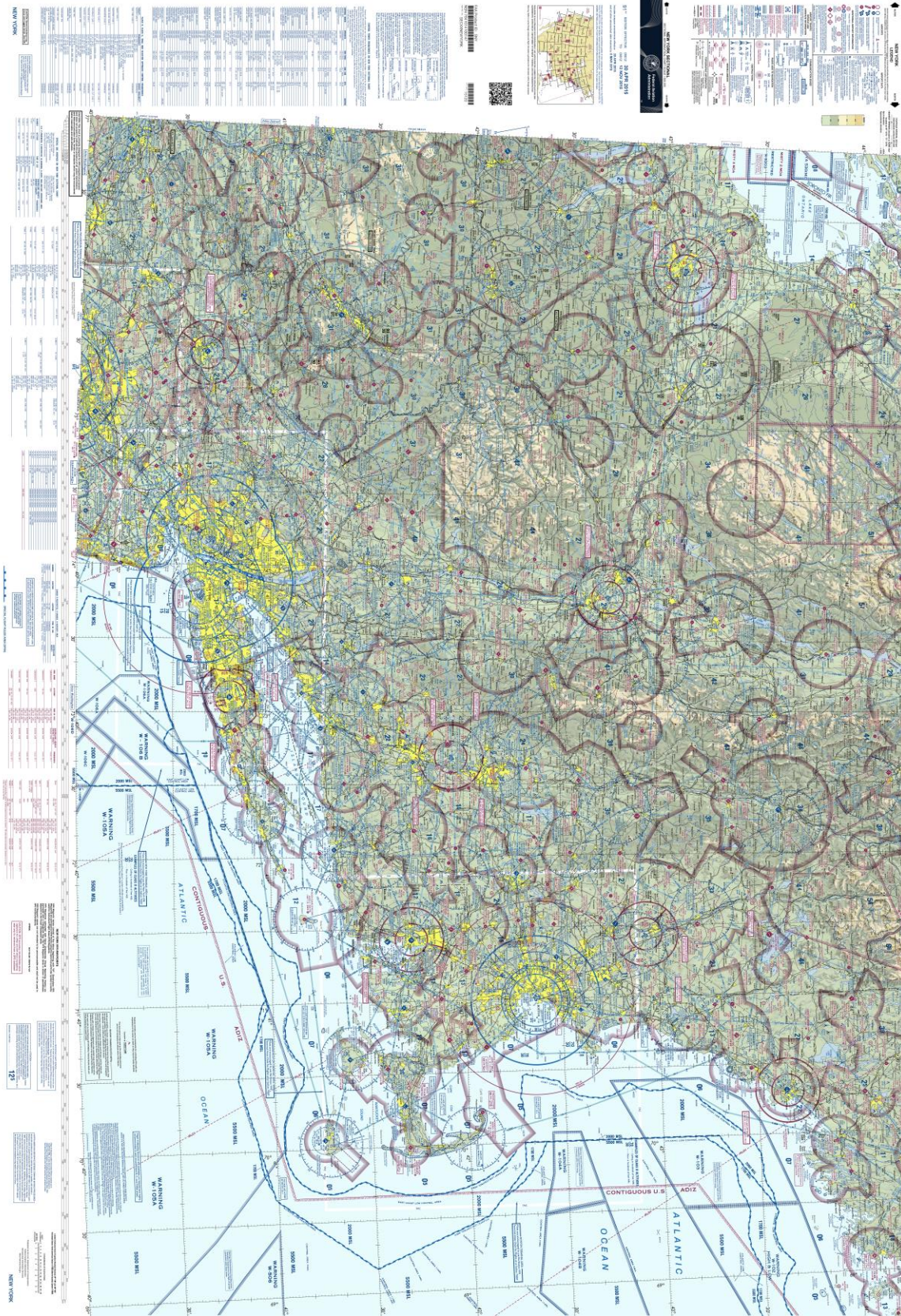
4 Detailed Outline (Optional)		
Lesson/Step Unit	Description	Details: Materials/Resources, Modifications, Extensions
Lesson 1	Aviation Charts	PowerPoint Presentation – Digital TAC Charts, Chart handouts, pencils
Lesson 2	Longitude and Latitude	Google Earth Pro, Longitude and Latitude handout
Lesson 3	The Magnetic Compass	Magnetic compasses, New York Sectional Chart, #2 pencils, straight edge, magnets, handout
Lesson 4	Initial Flight Planning	You Tube links: https://www.youtube.com/watch?v=pRJAU0y5RHY https://www.youtube.com/watch?v=9eJUioUWkPc Attached Powerpoint, plotters, pencils and Sectional Charts
Lesson 5	Creating a “no wind” Flight Plan	Plotters, pencils, Flight Plan log, Flight Plan Instructions and Sectional Charts

5 Activity Sheets	
5 - WAC Chart	Lesson 1 World Aeronautical Chart
6 – Sectional Chart	New York Sectional Chart
7 – TAC Chart	Boston Terminal Area Chart
8 – Questions/Definitions	Questions and definitions on the three chart types
9 -12 – Aviation Longitude and Latitude	Google Earth activity on determining Longitude and Latitude
13 – Magnetic Compass	Outdoor activity determining magnetic north
14 – Plotter	Image of an Aviation Plotter
15 – Using the Plotter	Practical directions on using the plotter for three courses
16, 17 – Charting your Course	Directions on charting a course of your own choosing
18 – VFR Flight Plan	Simplified version of a VFR Flight Plan

World Aeronautical Chart (WAC)



New York Sectional Chart



Boston Terminal Area Chart (TAC)

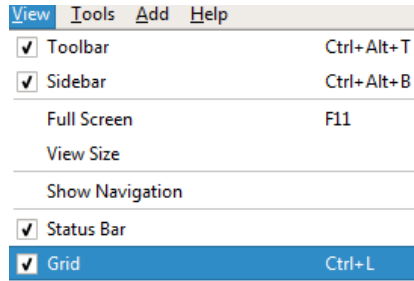


NOTES:

1. This chart is a reproduction of the original chart as published by the FAA. It is not to be used for navigation.
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1. Define “Pilotage”
2. Define “Dead Reckoning”
3. What is a WAC chart and why would we use one?
4. What is a TAC chart and why would we use one?
5. How are “Populated Areas” depicted on the TAC?
6. How are Controlled Airports depicted on the TAC? Uncontrolled Airports?
7. What is the difference between Controlled and Uncontrolled airports?
8. Why is it important that a pilot know the “Quadrant Elevations”?

Aviation Longitude and Latitude



Open **Google Earth Pro** > **View**> **Grid**

What is the Longitude of the **Prime Meridian**? _____

What is the Longitude of the **Antemeridian**? _____

What is the Latitude of the **North Pole**? _____

What is the Latitude of the **South Pole**? _____

Find an airport with two intersecting runways. List the four Longitude/Latitude points that define the “Numbers” of the runway. Use Degrees (°), Minutes (') and Seconds (") - with Decimal.

Airport _____

Example – RWY 15 Latitude 41°40'48.75"N Longitude 70°57'50.54"W

RWY

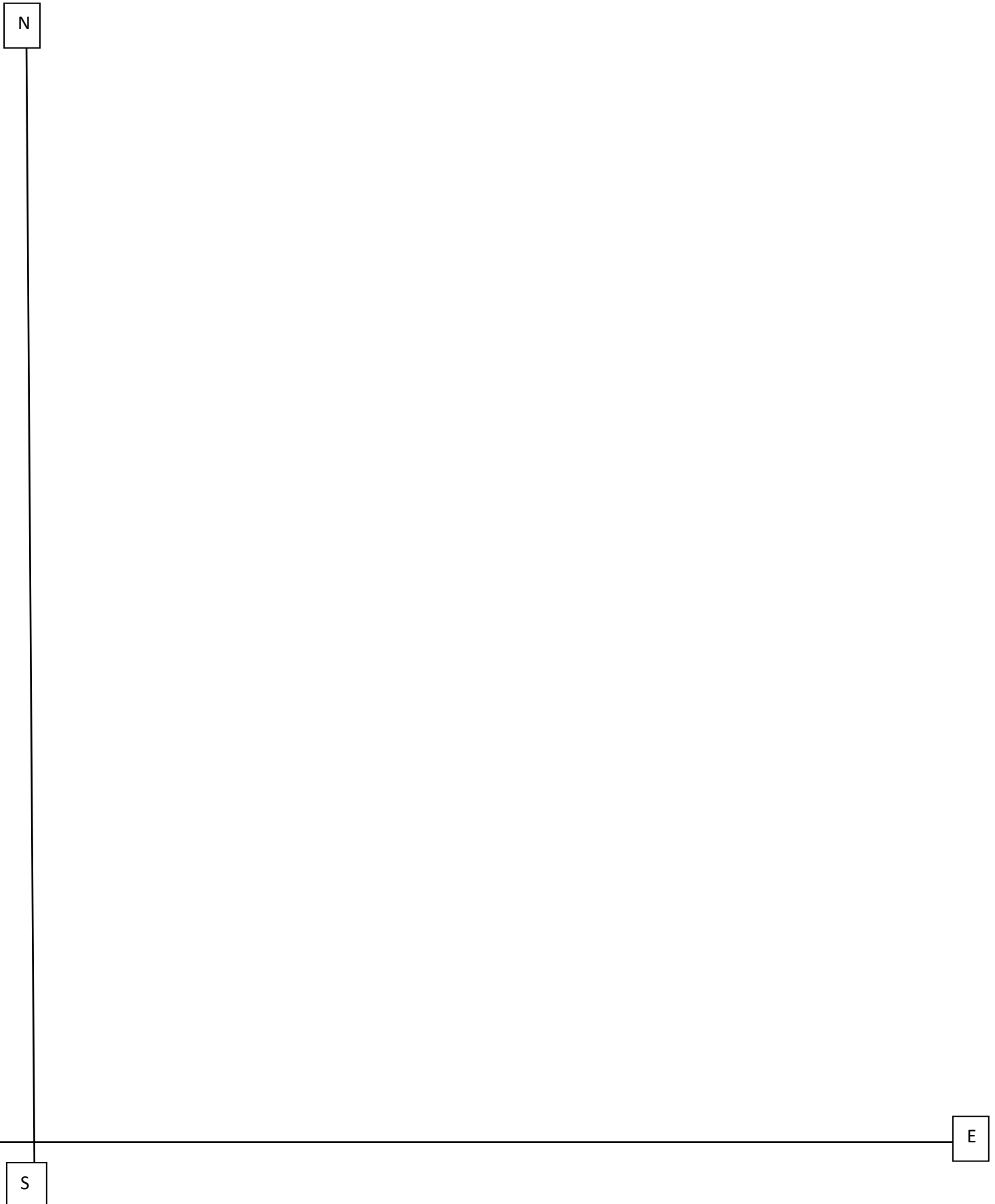
_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

Sketch the runway layout based on True North



Questions – Answer each question in a complete sentence.

1. Explain what is meant by this position report: “Aircraft is approximately located at 41°42' North Latitude, 71° 3' West Longitude.”

2. What is the meaning of a runway number? What is the accuracy of the runway number?

Second Airport _____

Example – RWY 15 Latitude 41°40'48.75"N Longitude 70°57'50.54"W

RWY

_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

_____ Latitude _____ Longitude _____

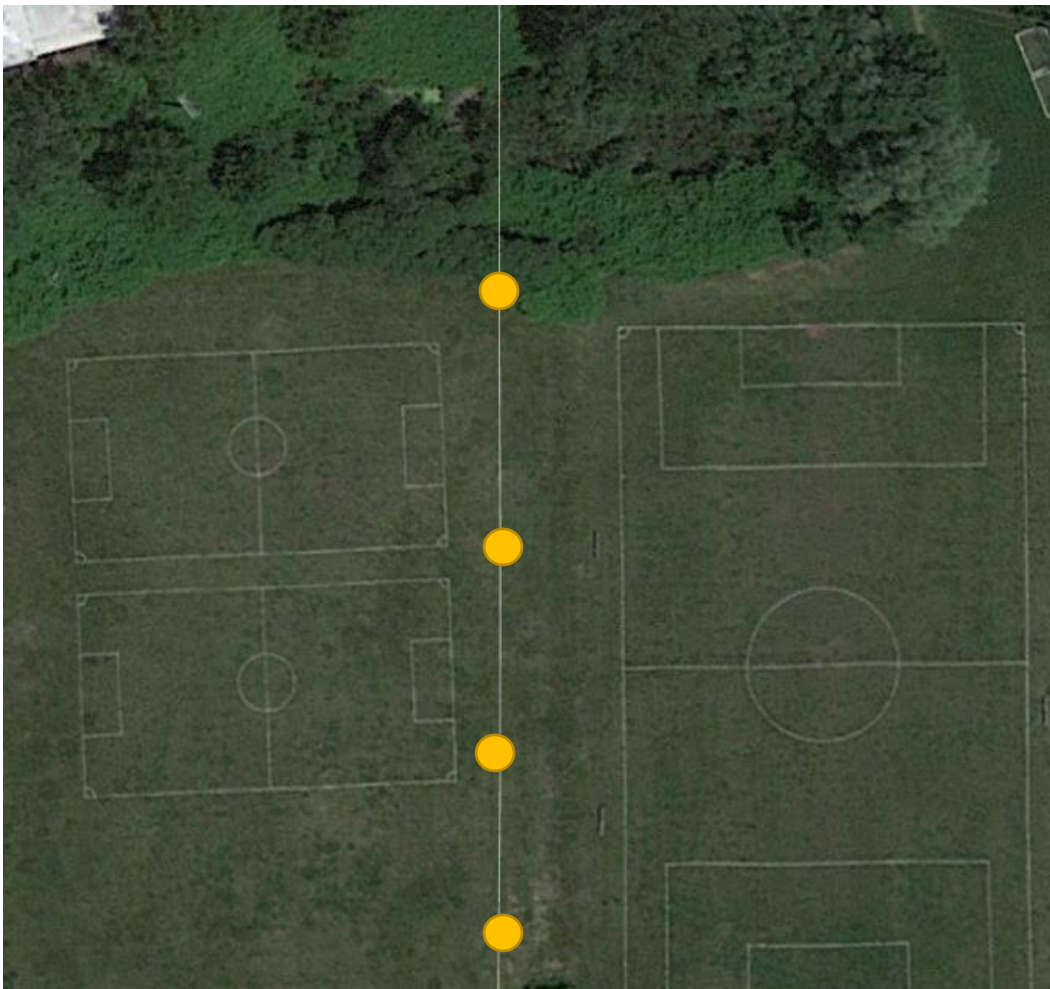
How many “Nautical Miles” are there between your two airports?

What would your “Heading” be?

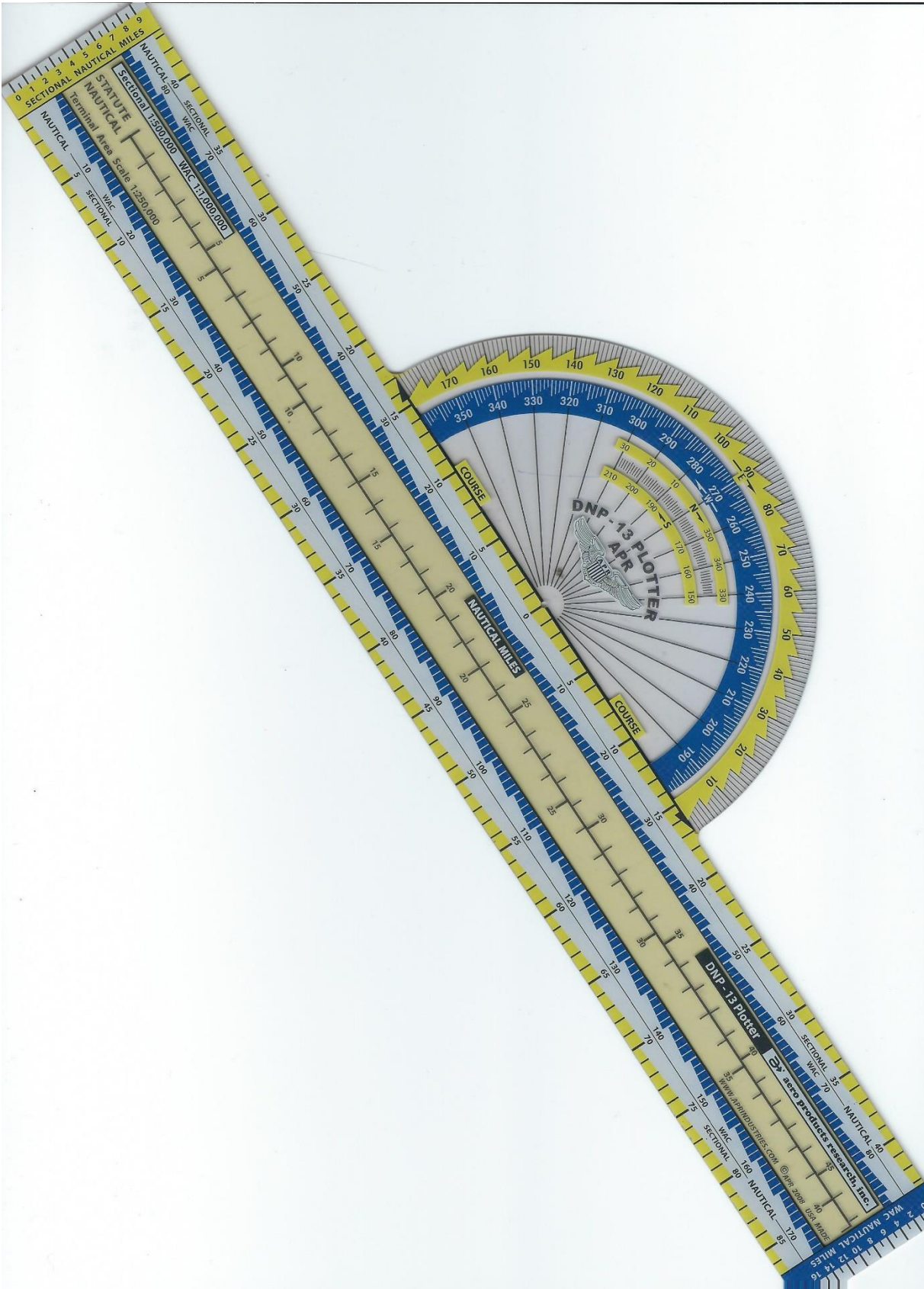
Topic to investigate: Would your heading be a “True” heading or a “Magnetic” Heading?

Magnetic Compass – Questions and Answers

1. What are the four “Cardinal Headings?”
2. What is the approximate location of Magnetic North?
3. Stand and face north on the Longitude Line in the soccer field.
4. Align North with your position within any two cones. Stay at least 6 feet away from any other students.
5. Rotate the compass so that north aligns with the compass needle.
6. What is the magnetic deviation between True North and Magnetic North on your compass?



Aviation Plotter



Using a Plotter

1. What are the three main uses of a Plotter?
2. How long is a Statute Mile?
3. How long is a Nautical Mile?

Plotting your course from Norwood Municipal Airport to Turner's Falls Airport

1. Using your plotter as a straight edge, draw a line with a pencil from Norwood to Turner's Falls.
2. Align the small circle in the middle of the plotter to the nearest line of longitude.
3. Record the westerly course. The number must be between 181 and 359.
4. Find the Magnetic Variation by reading it on the nearest Isogonic line. It will be a dashed line at an angle to the line of longitude. There are four of these on your chart. Which of the four will you use? Hint – it will be a number followed by the degrees symbol (°).

5. Now let's do some calculations:

True Course _____

Magnetic Variation _____

Magnetic Course _____

6. Choose two different airports and plot your course.

Departure Airport _____ Destination Airport _____

True Course _____

Magnetic Variation _____

Magnetic Course _____

Departure Airport _____ Destination Airport _____

True Course _____

Magnetic Variation _____

Magnetic Course _____

Charting your Course

Aircraft – Choose one by circling:

Piper Warrior Cessna 152 Beech Bonanza Aeronca Champ Cirrus SR20 Mooney M20

Call Sign – N_____

(choose any combination of letters and numbers. The letters and numbers must be appropriate).

Instructor Approval _____

1. Find the **True Airspeed (TAS)** and **gallons per hour in cruise flight (GPH)** for your aircraft using Internet research
 - a. TAS _____
 - b. GPH _____
2. On your **New York Sectional** chart, choose an airport for your **departure**.
3. Select a **destination** airport of at least 100 nautical miles straight line distance from your departure.
4. Choose an altitude between 3500 and 8500 feet.
 - a. Traveling east – use odd thousands plus 500 feet (e.g. 5,500 feet)
 - b. Traveling west – use even thousands plus 500 feet (e.g. 4,500 feet)
5. Determine the following numbers and input them onto your Flight Plan
 - a) Winds are “Calm” – zero for this activity
 - b) True Course – use your Plotter
 - c) Wind Correction - zero for this activity
 - d) True Heading – same as True Course for this activity
 - e) Magnetic Variation – Find the Isogonic line closest to your course
 - f) Magnetic Heading
 - g) Ground Speed – same as TAS for this activity
 - h) Total Miles
 - i) Total Time
 - j) Fuel Required
 - k) Leave the “Remarks” section blank.
6. Choose five visible check points along your route of flight
7. Use the current clock time for Departure Time.
8. Under **Wind Speed and Direction**, write **“Calm”**. This will result in a **zero wind correction angle**. This means that for this activity, True Airspeed and Ground speed will be the same

9. Determine “Total Time” by using this formula: **Miles Flown/Ground Speed X 60 = Total Time in minutes**

Example:

Miles Flown - 135

Ground Speed – 295

$135/295 \times 60 = 27.45$ minutes, approximately 27 minutes and 26 seconds

10. Determine Fuel Required using this formula: **Total Time/60 X GPH = Fuel Required**

Example:

Total Time = 27.45 minutes

Gallons Per Hour (GPH) = 42 (Where did we get that?)

$27.45/60 \times 42 = 19.215$ Gallons of fuel

11. Determine the point-to-point distances between check points.

12. Determine the Distance Remaining. How will you do this?

BONUS!!

Figure out the ***Estimated Elapsed Time*** and the ***Estimated Arrival Time*** on your flight plan.

Why do you think ***CLOSE YOUR FLIGHT PLAN*** is printed at the bottom of the Flight Plan?

VFR Flight Plan

ALTITUDE					HEADING					GPH
True Air Speed	Winds Direction Speed	True Course	Wind Correction	True Heading	Variation +W -E	Magnetic Heading	Ground Speed	Total Miles	Total Time	Fuel Required

Time Off	Distance		Elapsed Time		Arrival Time		Remarks
Check Points	Point to Point	Dist. Remain	Estimated	Actual	Estimated	Actual	
1							
2							
3							
4							
5							

CLOSE YOUR FLIGHT PLAN!!