

Ex. 23 - Navigation



What you will learn:

- ✓ To use the CFS, VNC, VTA, weather packages, NOTAMS and FSS to plan a cross-country flight
- ✓ To file a flight plan
- ✓ How to stay on track and avoid getting lost
- ✓ To get back on track if you drift off.

Why learn this:

- ✓ Want to go places! No street signs in the air.
- ✓ Many factors need to be taken into account to ensure a safe arrival to intended destination
 - time
 - weather
 - terrain
 - fuel
 - airspace restrictions

Links:

- ✓ You have already used a variety of resources to obtain information for local flights
- ✓ You have used VNC and VTA charts
- ✓ You have an understanding of airspace structure and requirements
- ✓ You have been introduced to E6B flight computer
- ✓ You have set up plane for cruise
- ✓ You practiced recovery from unusual attitudes and emergency situations.

Let's see how much you already know:

- Q What are WAC, VNC and VTA? What are their scales?
- Q What do the following VNC symbols stand for?

AERODROMES

Aerodrome symbols may be offset for clarity of presentation
For services and other data see the Flight Supplement

WITH SERVICES

WITH HARD SURFACED RUNWAYS

OTHER AERODROMES

- Land
- Heliport
- Other symbols

AERODROME DATA

NAME (M)	NAME (R)
371 L H53AT22.2 DAYS 60	371 S

AIRSPACE INFORMATION

All bearings are magnetic

Controlled airspace below [redacted] is shown
Transponder Mode [redacted] required in all class "B" and "C" airspace.

Class [redacted] control zone with ceiling 3000 feet ASL
(Above aerodrome elevation 2700 feet)

Canada: CYA - [redacted] CYD - [redacted] CYR - [redacted]
USA: A - Alert, P - Prohibited, R - Restricted, W - Warning

AREA ACTIVITY CODES
(A) [redacted] (F) [redacted] (H) [redacted]
(M) [redacted] (T) [redacted] (P) [redacted]
(S) [redacted] (I) [redacted]
MOA - Military Operation Area (USA)
Altitudes are inclusive unless otherwise indicated.
(CZOM) - NOTAM file indicator.

NO SVFR Fixed-wing special VFR flight is prohibited (USA)

TORONTO

RADIO AIDS TO NAVIGATION

Radio/Navigation facilities not operated by Nav Canada or Department of National Defence and Commercial Broadcasting Stations are subject to outage or change without NOTAM

VDF = VHF/DF UDF = UHF/DF VUDF = VHF/UHF/DF
Compass roses are oriented on magnetic north unless otherwise indicated.

RADIO AIDS TO NAVIGATION DATA BOXES

TORONTO
112.15 YHZ
DME Ch 58(Y)

VHF/UHF Navigation Aids.
DME available on frequency or channel.
TACAN mode "Y" must be used.

HALIFAX
115.1 YHZ
DME Ch 98
248 HZ

Type of naivad

KAMLOOPS 223 YKA (LF/MF Navigation Aids)

AIR/GROUND COMMUNICATION BOXES

HEAVY LINE BOXES indicate FSS with Standard Group frequencies
Other frequencies available are shown [redacted] where?
Barred frequencies (e.g. 440.0) are not available.
In the USA heavy line boxes indicate Flight Service Stations with standard frequencies 255.4, 122.2 and emergency 243.0, 121.5.

THIN LINE BOXES - Frequencies above box are remoted to site indicated in box from site shown below box.
Those without frequencies and controlling FSS name indicate no FSS frequencies available.

RCO or DRCO combined with Navaid
126.7

RCO or DRCO not associated with Navaid
243.0 123.275

QUEBEC 126.7 (bcst) DRCO

FSS opr fld hrs 0/T see CFS

DRCO - dialing instructions described in CFS.

A/G Private Air/Ground Station. Only shown when more than 75 nautical miles from public station.

CARS AIRPORT RADIO (ARPT RDO) Community Aerodrome Radio Station (CARS)

MISCELLANEOUS

Marine Light. White unless annotated.

Lighting Annotations
Al - alternating white and red if colour not indicated, F - fixed, Fl - flashing, Iso - equal interval, Q - quick flashing, Oc - occulting, Fl(3) - group flashing, Oc(2) - group occulting, SEC - sector, sec - second, W - white, R - red, B - blue, G - green, Y - yellow, (3) - number of flashes for time period.

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VNC Navigation Chart Legend

AERODROMES

Aerodrome symbols may be offset for clarity of presentation
For services and other data see the Flight Supplement

WITH SERVICES

WITH HARD SURFACED RUNWAYS



Only usable runways are shown.
Patterns drawn at chart scale

WITHOUT HARD SURFACED RUNWAYS



LAND
WATER

OTHER AERODROMES



AERODROME DATA

NAME (M)	NAME (R)
371 H53A122.2	371 S
DAYS 60	

NAME (M)	NAME (R)
371 L 53M122.3	371 S
DAYS 60	

NAME (M)	NAME (R)
371 L 53M122.3	371 S
DAYS 60	

NAME (M)	NAME (R)
371 L 53M122.3	371 S
DAYS 60	

AIRSPACE INFORMATION

All bearings are magnetic

Controlled airspace below FL 180 is shown
Transponder Mode C required in all class "B" and "C" airspace.



Compulsory/on request reporting points

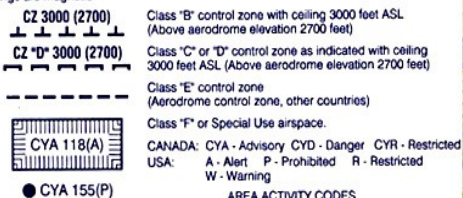
Changeover Point (Not shown at midpoint locations)

MODE C

Transponder Mode C required

Boundary between controlled areas with different floors.
Floors are 2200 feet AGL in Canada and 1200 feet AGL in U.S.A. unless otherwise indicated. 700 feet is AGL.

Class of airspace



Class "B" control zone with ceiling 3000 feet ASL
(Above aerodrome elevation 2700 feet)

Class "C" or "D" control zone as indicated with ceiling
3000 feet ASL (Above aerodrome elevation 2700 feet)

Class "E" control zone
(Aerodrome control zone, other countries)

Class "F" or Special Use airspace.

CANADA: CYA - Advisory CYD - Danger CYR - Restricted
USA: A - Alert P - Prohibited R - Restricted
W - Warning

AREA ACTIVITY CODES

(A) Acrobatic (F) Aircraft Test Area (H) Hang Gliding
(M) Military Operations (P) Parachute Dropping
(S) Soaring (T) Training
MOA - Military Operation Area (USA)
Altitudes are inclusive unless otherwise indicated.
(CZQM) - NOTAM file indicator.



All National, Provincial and Municipal Parks are closed to aircraft unless otherwise specified in the A.I.P. Canada and/or the supplements or by prior permission of the appropriate park authorities.

TORONTO

RADIO AIDS TO NAVIGATION

Radio/Navigation facilities not operated by Nav Canada or Department of National Defence and Commercial
Broadcasting Stations are subject to outage or change without NOTAM
VDF = VHF/DF UDF = UHF/DF VUDF = VHF/UHF/DF
Compass roses are oriented on magnetic north unless otherwise indicated.



RADIO AIDS TO NAVIGATION DATA BOXES

<p>TORONTO 112.15 YZ ≡≡≡ DME Ch 58(Y)</p>	<p>VHF/UHF Navigation Aids. DME available on frequency or channel. TACAN mode "Y" must be used.</p>	<p>HALIFAX 115.1 YHZ ≡≡≡ DME Ch 98 248 HZ ≡≡≡</p>	<p>Combined VHF/UHF and LF/MF Navigation Aids.</p>
<p>KAMLOOPS 223 YKA ≡≡≡</p>	<p>LF/MF Navigation Aids.</p>	<p>TACAN and DME channels are without voice and are not underlined. (Private) indicates NON Nav Canada/DND facility. TWB-Transcribed Weather Broadcast. Underline indicates no ATS communication on this frequency.</p>	

AIR/GROUND COMMUNICATION BOXES

HEAVY LINE BOXES indicate FSS with Standard Group frequencies
126.7, 121.5, 243.0.

Other frequencies available are shown above the box.

Barred frequencies (e.g. ~~243.0~~) are not available.

In the USA heavy line boxes indicate Flight Service Stations with
standard frequencies 255.4, 122.2 and emergency 243.0, 121.5.

<p>FSS combined with Navaid</p> <p>243.0 122.5</p>	<p>FSS not associated with Navaid</p> <p>243.0 122.5</p>
<p>FSS opr ltd hrs O/T see CFS</p>	<p>FSS opr ltd hrs O/T see CFS</p>

O/T see CFS - indicates other communication services
available outside FSS hours. See CFS for details.

THIN LINE BOXES - Frequencies above box are removed to site
indicated in box from site shown below box.

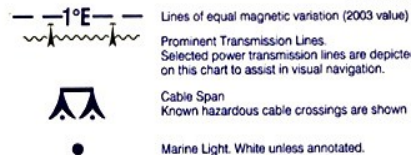
Those without frequencies and controlling FSS name indicate
no FSS frequencies available.

<p>RCO or DRCO combined with Navaid</p> <p>126.7</p>	<p>RCO or DRCO not associated with Navaid</p> <p>243.0 123.275</p>
<p>QUEBEC 126.7 (bcst) DRCO</p>	

DRCO - dialing instructions described in CFS.

<p>A/G</p>	<p>Private Air/Ground Station. Only shown when more than 75 nautical miles from public station.</p>
<p>CARS</p>	<p>AIRPORT RADIO (ARPT RDO) Community Aerodrome Radio Station (CARS)</p>

MISCELLANEOUS



Lines of equal magnetic variation (2003 value)

Prominent Transmission Lines.
Selected power transmission lines are depicted on
this chart to assist in visual navigation.

Cable Span
Known hazardous cable crossings are shown

Marine Light. White unless annotated.

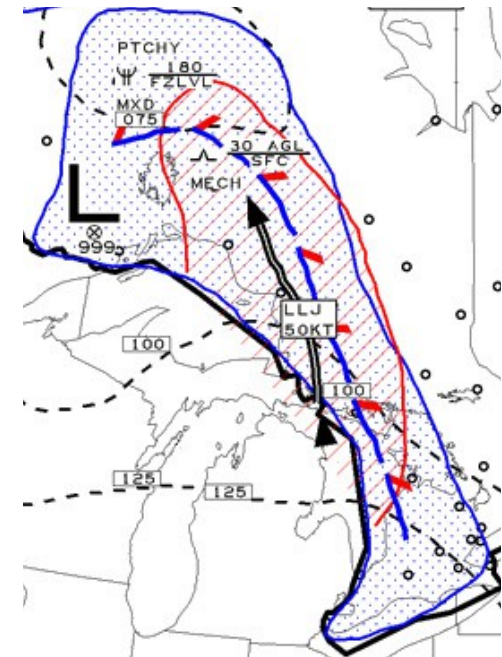
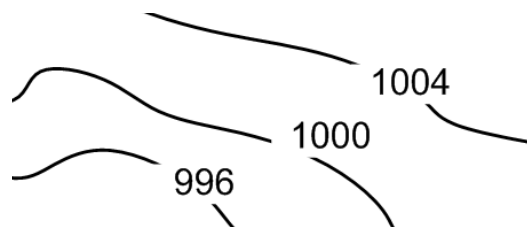
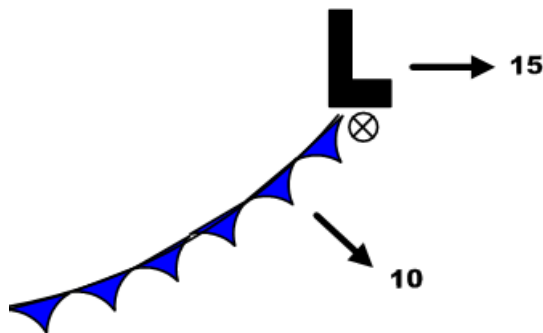
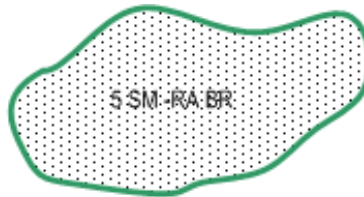
Lighting Annotations

Al - alternating white and red if colour not indicated, F - fixed, Fl - flashing,
Iso - equal interval, Q - quick flashing, Oc - occulting, Fl(3) - group flashing,
Oc(2) - group occulting, SEC - sector, sec - second, W - white, R - red, B - blue,
G - green, Y - yellow, (3) - number of flashes for time period.

The Maximum Elevation Figure (MEF) shown in quadrangles
bounded by ticked lines of latitude and longitude is in
THOUSANDS and HUNDREDS of feet above sea level. The
MEF is based on information available concerning the highest
known feature in each quadrangle, including terrain and
obstructions (trees, towers, antennas, etc.)

Let's see how much you already know:

- Q Where can you find out the meaning VNC symbols not shown on the VNC legend?
- Q Tell me all you can find out from the CFS about Muskoka
- Q What is GFA? What are the two kinds of GFA?
- Q What are the following GFA symbols stand for?



Let's see how much you already know:

Q Decode the following METAR:

METAR CYXX 090000Z 36004KT 15SM FEW065 BKN220 18/00 A3012 RMK CU1CI2CU TR SLP201=

Q What is the difference between METARs and TAFs?

Q What are NOTAMs?

Q Where can you find a list of abbreviations used in NOTAMs?

Q Are the following given in degrees magnetic or true?

Q wind

Q runways

Q latitude and longitude lines on VNC

Q VOR compass rose?

Q What is E6B and what are some of the things it is used for?

Q What documents are required on board for a cross-country flight?

Theories and Definitions:

- ✓ Flight Planning
 - Weather Package
 - Selecting Track
 - Selecting Departure Method
 - Preparing a Chart
 - Navigation Logs (front and back), Flight Plan Form
- ✓ Filing a Flight Plan/Itinerary
- ✓ Drift Correction Methods.

Flight Planning: Weather Package

<https://flightplanning.navcanada.ca>--> Route Data

- ✓ Enter route, Suggest Selecting:
 - Weather with NOTAM (aerodrome NOTAM – corridor)
 - SIGMET, AIRMET, Volcanic Ash
 - PIREP, METAR/TAF
 - GFA (CLD & WX and ICG, TURB & FZLVL), UPR WIND & TEMPS (FD)
- ✓ <http://www.weatheroffice.gc.ca/radar/>, while not an official aviation website, is a good source for radar data.

Flight Planning: Selecting Track

- ✓ Track-straight line from start-finish...close to airports

- ✓ Hard to make a straight line due to
 - terrain/obstacles enroute
 - poor weather enroute
 - airspace structure
 - bodies of water
 - availability of alternate airports How far off shore can you fly?
 - ease of navigation (proximity of good landmarks, radio navigation aids)
 - sightseeing.

Flight Planning: Departure Method

What would be an appropriate departure method for your home field?

✓ Overhead Departure

- climb to cruise altitude in the vicinity of aerodrome
- use aerodrome as a starting fix
- big mountains all around, need to climb

✓ Set Heading Point

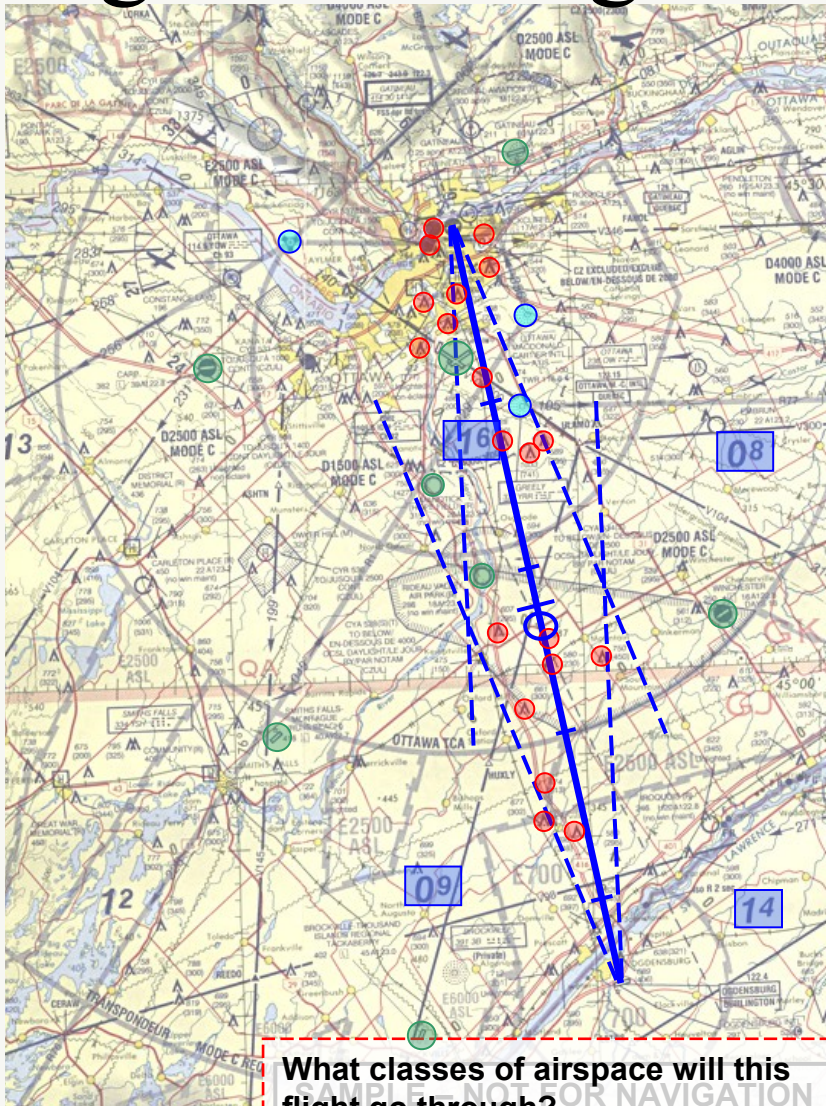
- after take-off head to landmark a short distance away
- often used- busy airspace, saves time, fuel

What are some good set heading points in the vicinity of our airport?

✓ En route Climb

- intercept track shortly after departure
- short and direct but slightly harder to plan and may create a high-workload situation.

Flight Planning: Preparing a Chart



- ✓ Draw line for each leg
- ✓ Mark halfway point
- ✓ Mark 10 NM points
- ✓ Draw 10° drift lines (dashed)

✓ Mark checkpoints What would make a good checkpoint?

- prominent, easily identifiable landmarks
- spaced out every 15-30 nautical miles

✓ Note obstacles, MEF, airspace structure

What determines the altitude you choose to fly at?

✓ Note alternate aerodromes and potential landing sites

✓ Note radio navigation aids.

What classes of airspace will this flight go through?

Flight Planning: Navigation Log

$V_R =$	$V_X =$	$V_Y =$	$V_A =$	$V_{MAXGLIDE} =$																		
		Takeoff		Maximum			Landing															
Weight																						
Moment		Check CG Moment Envelope																				
Ground Roll																						
Distance To Clear 50'																						
Runway Length																						
													Total Fuel									
Check Points	VOR	Course	Altitude (MSL)	Wind		TAS	TC -L +R WCA	TH -E +W Var.	MH ±Dev.	CH	Dist. Leg Rem.	GS Est. Act.	Time Off		GPH Fuel Rem.	Departure	ATIS/Airport Advisories	Destination				
	Freq. Ident.			Dir.	Vel.								Temp.	ETE			ETA		ATIS Code			
																	Wind					
																	Visibility					
																	Ceiling					
																	Altimeter					
																	Approach					
																	Runway					
Airport Data																						
															Departure		Destination					
																	ATIS	ATIS				
																	Grnd	FSS				
																	Tower	App.				
																	Dep.	Tower				
																	CTAF	CTAF				
																	FSS	Grnd.				
																	TPA	TPA				
																	Field Elev.	Field Elev.				
															HOBBS In:		Log Time					
															HOBBS Out:							
Close Flight Plan															Totals:							

Can you make your own nav log?

Fill in what you want-use a blank sheet of paper with the course and time if that works for you.

File a Flight Plan/Itinerary

- ✓ Flight plan or flight itinerary required:
 - when flying past 25 NM from base

- ✓ Flight plan required:
 - for transborder flights
 - for flights penetrating ADIZ

How long after estimated arrival time will search and rescue operations commence if a flight plan has not been closed?

<https://flightplanning.navcanada.ca> or 1-866-WX-BRIEF

- ✓ Open flight plan with TWR, FSS or CARS

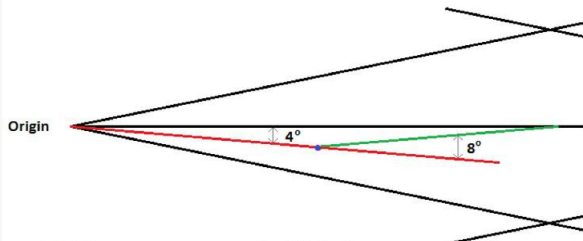
- ✓ Close flight plan with ATC or FSS

Drift Correction Methods

Visual Alteration-think you recognize something on track, head for it, get lost if wrong

Double Track Error Method

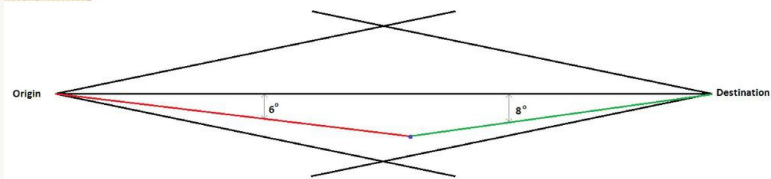
- At (•) you are 4° right of your track after 10 mins



- Alter your track 4° left to parallel your track
- Alter your track 4° more left to intercept your track
- After 10 mins using the 8° correction you intercept
- Alter track 4° right to regain intended track

Opening and Closing Angles Method

- At (•) you are off track



- Your opening angle is 6° right of track
- Your closing angle is 8° to get to the destination
- Add opening and closing angles (12°)
- Subtract 12° to correct back to the left and go directly to destination

Procedures

- ✓ Flight Planning
- ✓ Departure
- ✓ Set Heading Point
- ✓ En route
- ✓ Arrival
- ✓ Lost Procedures.

Flight Planning

- ✓ Gather sources with information about planned flight
 - weather + NOTAMs
 - charts + CFS
 - POH + W&B chart
- ✓ Select route, altitude, type of departure based on info above
- ✓ Prepare chart
- ✓ Fill out Nav Log
 - Routing and associated calculations
 - Weight & Balance
 - Fuel calculations
 - Take-off and Landing Distances
 - Checkpoint data
 - Useful frequencies
 - Airport diagrams

Can you use the BEW figure from your POH?

File Flight Plan-easy @ <https://flightplanning.navcanada.ca>

Departure

- ✓ Before take-off, brief passengers, include ETA
- ✓ Mark take-off time on the Nav Log
- ✓ flight plan is open with Tower or FSS/FIC
- ✓ Fly toward set heading point or departure procedure
- ✓ Request flight following?

What is flight following and how can it be requested?

Set Heading Point

Set Heading

Time-record

Track (don't trust your pre-calculated heading!)

ETE (estimated time enroute – to next checkpoint and to final destination)

What calculations do you need to make to calculate ETE/ETA?

ETA (estimated time of arrival – to next checkpoint and to final destination).

Enroute

- ✓ **Look out!**
- ✓ Monitor weather, aircraft gauges
- ✓ From Watch-To Map-To Ground: time, find where should be on map, find features on map, then look out window for them
- ✓ Do NOT look out window, find random mountain, pick on map
- ✓ Correct drift promptly
- ✓ Make appropriate radio calls
 - to ATC if flight following or flying through controlled airspace
 - to other traffic if not in contact with ATC
 - to FSS with position reports, weather update requests etc.
- ✓ At checkpoints:
 - Time- record
 - Turn- new heading
 - Twist- heading indicator
 - Throttle- speed, altitude
 - Talk- ATC

What do you need to tell FSS when making a VFR position report?

What is the purpose of VFR position reports?

Arrival

- ✓ Plan your descent
 - too late – passenger discomfort
 - too early – flying at low altitudes/non-cruise altitudes for prolonged periods

- ✓ Appropriate circuit-joining procedures

- ✓ **CLOSE FLIGHT PLAN!**

Lost Procedures

- ✓ Everybody gets lost... temporarily unsure of their position
- ✓ Draw a line on the map
 - What was your last known position?
 - How much time passed since then?
 - What heading did you hold?
- ✓ From watch-to map-to ground: what *should* you see outside?
- Climb-better view, radio distance
- Confess-to ATC, 121.5 MHz
- Comply-with their advice
- ✓ Use radio navigation aids, pull out the GPS on your phone

How can you use a VOR to help determine your position? Two VORs?

Considerations

- ✓ Pilot and Passenger Comfort
 - remember to eat and drink before a long cross-country, bring snacks
 - no washrooms on the plane!
 - ensure sick bag, medical supplies are easily accessible
- ✓ Equipment Tips and Tricks
 - fold charts before the flight
 - bookmark CFS
 - use passengers as a resource (refolding charts, helping you look for landmarks and traffic)
 - use radio navigation equipment to cross-check visual navigation and dead reckoning
- ✓ Journey Log
 - must bring if plan to land and shut down anywhere other than point of departure
 - check that you have enough hours before the next inspection to complete the flight.

SAFETY

! Be aware of traffic situation:

! Look out

! Listen and broadcast your position on 126.7 or other common frequency

What are some common area frequencies?

! Request flight following whenever available

! If no flight following, make VFR position reports to FSS as necessary

! Amend flight plan with FSS if you're going to be 15 or more minutes late, or if any other change in original plans takes place

! If a diversion is necessary for safety reasons (e.g., weather, mechanical problems) – do not hesitate to divert.

Review

- Q Let's start planning a sample cross-country. Scenario:
- ☑ Departing in two hours
 - ☑ Toronto to Muskoka to Peterborough to Toronto
 - ☑ Pick your favourite plane
 - ☑ One passenger (standard male) and 50 pounds of cargo.

Conclusion

- ✓ Now you are able to accurately plan a trip to other airports
- ✓ Homework for next lesson: complete the cross-country planning
- ✓ Read for next lesson: Ex. 23, Diversion

QUESTIONS?