

TINA Great. Really great questions during the break. So appreciate that. Thanks.

SRIVASTAVA:

So this morning we started off with, you know, how airplanes fly. And Phillip talked you through the aircraft systems and what's going on inside an airplane that's helping that airplane function. This afternoon we're really going to focus on navigation. So we're going to talk about charts and airspace. And we're going to talk about the flight environment and how you navigate through it.

So let's get started with charts and airspace. So aeronautical charts, they kind of help you out with where you're going. So there are actually a number of electronic charts. So there are a couple of websites.

So skyvector.com is a great website that shows these charts. There's a search bar so you can type in an airport, for example. And it'll zoom right in to that chart. You can also get some apps. And I'm going to pass around my iPad.

There is a program called Foreflight. So how many people have used Foreflight before? So just a handful of you.

So there are a lot of different software. And Garmin has great software, too. I'm not really recommending any over the other, but this just happens to be on my iPad. I take this with me when I go flying. And so I have the app pulled up. So you can basically move around and look at the map.

And then I have a physical map that I will also pass around. Which this particular map is a VFR sectional map. So VFR is for visual flight rules, as opposed to IFR, which is instrument flight rules. It will have a whole talk just on instrument flight rules later. But for now, when you start flying you start with visual flight rules, which means that you can look outside the airplane, there are no clouds obscuring your view. And so this is a very giant and unwieldy document to have in your plane while you're flying.

And so this is why I don't carry this in the plane and I instead carry the iPad. But this sectional, there are actually different parts across the US where there are very busy areas with lots of airports. And so they have these sectional maps. So a section of the United States. And you

can look at those.

And so I'm going to pass this around as we talk through the slides, which zoom in to various parts of this for you to take a look at. OK, so I think the most important part of the sectional chart is the legend. And it basically answers all the questions that you're going to get on your exam about it, which asks you what all of these different do-hickies are. So we'll zoom in to a particular part.

So this is about an airport. So there's a lot of different data contained. And it can be a little bit overwhelming. So when you look at that chunk of text and data, you really can just look at a sectional chart's legend to tell you what all of that means. So this is the chunk of text, numbers, and letters that you would see on a sectional chart.

And then over here it explains what they are. So you can see what each thing is. So ATIS over here, which it's nicely defined over here, so you don't have to memorize anything-- Automatic Terminal Information Service, the ATIS, which is what provides weather information. We'll have a whole talk just about weather information and radar comms and air traffic control. But you can see here that there is a frequency, 123.8.

So that's telling you that in order to get the weather information for that particular airport, you'd turn to the frequency 123.8 and you can hear what the weather is. There's a lot of other data on here. So for example, it tells you some Automated Surface Weather or ASOS, 135.42. So you know that you can contact that frequency if you want to get the Automated Weather Service. So a lot of this data is listed there.

So we won't go through everything, because it is nicely defined in the legend. Another area we'll focus on are just what do airports look like. So over here is the part of the sectional that has Boston Logan Airport. So you see all these lines that are outlined in blue. So if you look over at the legend, it describes exactly what that means.

So having these lines outlined in blue, hard surfaced runways greater than 8,000 feet. And so it just tells you exactly what that information is. And smaller airports with shorter runways have these circles with lines. And the lines are generally trying to depict the runway. And so the line here will generally be aligned with what the direction of the runway is. And when there are two lines, that generally is representing two runways.

So this down here in the bottom right corner is a hand scan of Bedford. And so you can see

the two crossing runways here depicted here. So continuing along, there are also abandoned airports. So the actual airport has a X on it. And then you'll also see this X through the circle to represent that it's an abandoned place. So it still might be a good option if there's an emergency and you're really looking for a place to land. But it's not a good idea if you have the ability to get to a functioning open airport where you know the runways clear.

Other information that is provided in these charts and sectionals are whether or not fuel is available and what are the operating times of the tower. Because all that information changes very frequently, those sectional charts have to be updated. So that particular sectional that I'm passing around is out of date. They get out of date very quickly. For Foreflight, you can constantly download new maps. So before you fly, you kind of download everything and it refreshes, and then you have it good to go.

Another thing that a sectional chart is really good for is identifying obstacles. So these are the kind of descriptions of a tower, for example, or more than one a group of obstructions. And so it kind of tells you that there is an obstruction. So in the bottom right corner, we see there's an obstruction right here with this little triangle. And then it has two numbers. So it has 796. And then it has (335).

Now, it explains in words what that means. So the top number is the elevation above the mean sea level. And then the one in parentheses is the height above ground. Now, the way I like to remember it, it's a little bit morbid, but it really helps you remember it, is the number on top is the altitude that will be indicated on your altimeter if you hit the top of the obstacle. And then the number in parentheses is how far you will fall to hit the ground. So that's a good way of remembering what those two numbers are and what's the difference.

So any questions about sectional charts before I move on to airspace? Yes?

AUDIENCE:

On the previous slide, you were talking about the blue outline. But then there was a red outline.

TINA

Yes, so the question was about blue versus red outlines. That's in fact answered directly by

SRIVASTAVA:

different types of airspace. So it's a great transition. So I'll move straight into that.

So there are different types of airspace. And they're labeled with these letters. So in aviation speak, just to make sure we're being clear instead of saying B, we say bravo. Because we don't want to get confused did you say B, or C, or D? So you say Bravo. So we have these

different types of airspace. So uncontrolled airspace is Class G or Class Golf. And then you have the controlled airspace. So Class A, Class Bravo, Class Charlie, et cetera. And then there's some special use airspace.

So the short answer is the different colors of blue and purple represent different types of airspace, as well as different classes of airspace, and can represent whether you're close to certain types of airports. So the way to think about airspace-- now, there's a lot going on in this map. I agree with you-- but there are a bunch of circles that are going on. Well, one thing to keep in mind is that each circle is actually operating at a particular elevation. And so one way to think about it is that airspace is three dimensional and a lot of people think about it as a wedding cake, as an upside down wedding cake.

And the reason they think about it that way is that usually around a particular airport, like Boston Logan Airport, there is restricted airspace, right? They don't want you to just fly through because you could interfere with commercial traffic that's landing there. So they want you to have certain restrictions when you're close to an airport.

So the reason it looks like an upside down wedding cake is that when airplanes are being sequenced to come in, they're usually at pretty high altitudes because they've been flying across the country. So the restrictions on the airspace start high up. So you can actually fly underneath the Class Bravo airspace. So if you're flying on this side, so we show kind of to the left, you can be underneath the Class Bravo airspace. And the restricted space can be above you. But as you get closer to the airport, the restricted airspace goes all the way down to the ground, right, to the surface.

So it touches the ground around the airport because that's where the airplanes are landing. So that's why it's like a layer of the wedding cake that is lower and lower until it touches the ground. Does that makes sense? Great. OK, so here's a specific answer to the question you were talking about-- there are all kinds of different lines. What do they mean?

So if you see a solid blue line, that represents Class Bravo airspace. So that's like the airspace around Boston Logan Airport is Class Bravo. So you'll see a solid blue line. And the solid magenta line is Class Charlie airspace, which is for a usually slightly less busy airport. We'll define it in a moment. But you might have seen other lines, which are kind of these big fat kind of faded lines lower down. And so that really depends.

It usually is denoting some form of Class E airspace. And depending on where it is, it is in

effect different altitudes. And we'll dive into those minimums and descriptions in just a moment. So let's start at the top at Class A airspace. So this is very high up. Pretty much as a private pilot in a single engine airplane, you're never going to encounter this Class A airspace, because it starts at 18,000 feet. So it's pretty high up.

So pretty much only big jets, commercial jets, fly at that altitude. In order to fly into that altitude, you actually have to have your instrument flight rating. And we're going to have a whole lecture devoted just to instrument flight training. But really what it means is that you could be flying through clouds where you can't see outside the airplane to avoid other airplanes and you're just relying on your instruments. It requires also a lot more precision.

That when you say that you're at 20,000 feet, you have to be at 20,000 feet. You can't drift off to 21,000 feet. You have to stay put. And the reason is that when you're flying the instrument, you're relying on the air traffic controllers to sequence you. And so they have multiple airplanes in the same space. And they're basically depending that you'll be able to hold the altitude that they give you and the heading that they give you. And they might put another airplane relatively close to you, but they know that you can both fly very well and accurately so you're not going to hit each other.

So they have all kinds of airplanes up in the Class Alpha or Class A airspace. In fact, the pro tip is that most people just call it Class A even though you're supposed to say Alpha. Phillip talked a little bit about the altimeter setting and how the actual altimeter setting can vary from where you are. But since you have big jets that are traveling very quickly and they might cross multiple places with different altimeter settings, in Class A airspace, you actually have everybody using the exact same altimeter setting, 29.92. And that way everybody is viewing the same altitude as the other person at the same height so that everyone can make sure not to hit each other. And when anyone is supposed to be at 18,000, they're at the same altitude as the people around them.

OK, the next is Class Bravo. This is a lot more relevant to something that you might encounter. So over here, it's right around Boston Logan Airport. We heard Meenakshi talk about her time talking to JFK at Kennedy Tower right around New York. All of the busy airports have Class Bravo. So the way to remember Bravo is Bravo is busiest. So the busiest airports are Class Bravo.

You actually have to have an explicit clearance to enter. Someone has to say you're cleared

through the Bravo. If they don't tell you you're cleared through the Bravo, you're not allowed to enter that airspace. Even after you get your solo and you're a student pilot, you have to have a specific endorsement. Again, endorsement is a signature by your instructor that says you're allowed to enter that particular airspace. Your aircraft also requires specific equipment. And in particular, it needs a Mode C transponder, which basically helps to identify more accurately where the aircraft is.

And then we talked about this upside down wedding cake. So typically right in the middle of the wedding cake, right around the airport, it's from the surface to 10,000 feet. But it goes out wider starting at a higher altitude. So right here near Logan Airport, for example, there are parts of it where the Class Bravo doesn't start until 3,000 feet. So if you fly at 2,500 feet, you can fly right underneath the Class Bravo. You don't have to get clearance to fly there. And if you accidentally fly too high and you go through that 3,000 foot barrier, it's called busting the Bravo, and you're in big trouble, and don't do that.

OK, so again, Boston Logan Airport is right in the middle. And then the rings going around it show the different rising altitudes. So how do you know what the altitude is? So right in the center, it has a 70 and then a line that says SFC. So SFC means surface. So right in the center of the circle, it goes down to the surface. And then you see now the number change to 20. So you can go up to 2,000 feet. And out here, 30.

So that means if you're at 3,000 feet, up to 7,000 feet is where the restriction is. Below 3,000 feet, you're OK. OK, so now is Class Charlie. So they are also busy airports, but they're not quite as busy as the Class Bravo airports. So for example, Manchester, New Hampshire, Providence, Rhode Island. Here you're required to establish two-way radio communication, where they actually know the tail number of your aircraft. So every aircraft has a number. If it's a US aircraft, it usually has an N or November at the beginning. So you know, November 535, you know, Alpha Bravo. And so you actually have to say what your tail number is.

So in this example, 808 Whiskey Tango. But if you just say I'm an aircraft five miles to the south, they haven't identified you in particular. So that doesn't count as establishing the two-way communication. But once you have established two-way communication with the controller, you can enter without a specific clearance to enter the Class Charlie airspace.

So here's an example of that. So we have the airport in the middle. And now we have magenta lines instead of blue lines because it's a Class Charlie airspace instead of Class Bravo

airspace. So Class Delta, one of the airports we've been talking about, Hanscom, also known as Bedford, is a Class Delta airport.

And so here you have to establish two-way radio communication as well. It's indicated by a dashed blue line. So this is an example of Worcester airport. And you can see the dash blue circle around the airport.

OK, now Class E airspace is when you start getting a little complicated. So it's not necessarily related to a particular airport. And it really applies to just other controlled airspace around. And the reason that they have this airspace is to define certain weather restrictions. So how close and far you can be from clouds, what the visibility needs to be in order for you to fly in these environments. So it can be indicated in a lot of different ways. It gets very confusing. So we have both magenta blurry lines and blue blurry lines. And the legend, of course, is your friend. It defines exactly what it means and why it's a different color.

And you can see those throughout. So sometimes like when we were flying to Bar Harbor as we talked about earlier along the coastline, you might see those restrictions or around a small airport. So now let's zoom back out this big picture. You might see a whole bunch of things going on in the sectionals that are coming around the room. It looks very complicated.

But now you kind of know what the little dots mean. You also see some yellow. The yellow indicates a congested area. So there might be like dense population over there. So that's relevant, because you're not supposed to fly low over a congested area. But it's also helpful when you're flying around to identify where you are, that, oh, OK, I'm over a city versus I'm over just some fields.

There are also airways on those sectionals and maps being passed around, which are indicated by these kind of blue lines with an arrow on it with a heading. So what I mean by heading is like if it says 132 degrees. And so these airways are places that sometimes an airplane gets told to follow a particular airway, might be the fastest way to get from one place to another.

So here's an example of an airway on the sectional. You can see these blue lines kind of cutting across. And then another relatively confusing airspace is this Class Gulf airspace. And it basically is uncontrolled airspace. You can do whatever you want. You might see this over a desert. You won't see any of this in the Northeast. There are too many airports and too many things going on.

But in the middle of the country or in certain places that are not as populated, you'll see this uncontrolled airspace. And you can do whatever you want. So the memory aid here is Golf means go for it. So here's the summary.

So Class Bravo is that upside down wedding cake. And then you get the Class Charlie, Class Delta. And then Class E is kind of everywhere that doesn't have other restrictions. And then Class Golf is unrestricted.

Now each of those types of airspace-- so A, B, C, D-- they all have some specific requirements associated with them. So for example, we talked about in Class A airspace you have to be instrument rated. In Class Bravo airspace, you might need to get a special endorsement to be able to fly there. Then the entry requirements.

So Class Golf is go for it. You can fly in Class Golf airspace without talking to anyone about anything. You just take off and you fly. Whereas we talked about, for example, Class Bravo where you need explicit clearance to enter the airspace. And then come all of the visibility or minimums, as they talk about. These are prime candidates for the FAA exam, because they're just things you basically have to remember.

So Class A airspace, you already have to have an instrument rating, which means, hey, there can be instrument conditions, which means it can be cloudy, you could be flying in a cloud. So there's no specific visibility requirement. There could be zero visibility and you could be flying. So that's why it says N/A for all of the Class A visibility.

But on the other ones, there are some more restrictions. And so for example, when you're in Class Bravo airspace, you have to remain clear of clouds. The reason that they don't have more stringent restriction, you know, that you have to be 1,000 feet away from a cloud is because they're really watching everybody in that airspace and moving them around. So they can generally make sure that there isn't an airplane in a cloud that's about to pop out and hit you. You're already aware of all the other aircraft.

Whereas when you have less control and they're not air traffic controllers necessarily talking to everyone, they want to make you stay farther away from a cloud. Because if you're in a cloud, if you're near a cloud, you may not see an aircraft that's on the other side of the cloud. And then you could have a collision. So there's also a fair amount of special use airspace.

So there's restricted areas. Oh, yes. Go ahead?

AUDIENCE: How do you know how far away you are from a cloud?

TINA SRIVASTAVA: That's a great question, how do you know how far you are from a cloud? There's no good way to know. You're just supposed to guesstimate really by looking outside the window and looking at the cloud. If you're near an airport, then you might know what the runway length is. So you can use that to kind of gauge distances. But there isn't a hard and fast rule of knowing how far you are from a cloud.

AUDIENCE: What do you mean?

TINA SRIVASTAVA: Well, clear of clouds is really easy. You just don't go in the cloud. I would say there is not a very good way of knowing whether you're 1,000 feet or 2,000 feet away from a cloud. In general, I use those as guidance that, OK, I should basically stay as far away from the clouds as possible. So if there's a cloud near me, I'll turn off course. Whereas if it's just clear of clouds, I'm willing to come right underneath that cloud. Good question.

OK, so restricted area. So some restricted areas, restricted areas are either hot or on, or they're cold and they're not active. So you only have to avoid a restricted area if it's hot. So if you're already in communication with air traffic control, you could just ask them if a particular restricted area is active or not. There are also some prohibited areas, like over president's houses.

And then there are temporary flight restrictions, or TFRs. And they can be very complicated. We'll talk about a couple in particular. So around the stadium, you're not supposed to fly there. Around Disney World, you're not supposed to fly low over Disney World. And sometimes if the president is traveling somewhere, there will be a temporary flight restriction. And it might not tell you that it's the president. It might just say a VIP is in the areas. So you're not allowed to fly.

And then there's certain areas that you just have to proceed with caution, but you're allowed to enter. So alert areas, military operation areas, and other warning areas. You just want to be especially alert when you're in those spaces. And then, again, you have a whole bunch more blue and magenta lines that mean different things that basically describe all of the different types of environments that we talked about. So I think the one you're most likely to encounter is this one that's very close to Minuteman Airport. So this is really just west of Hanscom.

There's a small area there. It's not usually active. But if it is, it's one that you want to keep an eye out.

And then we talked about TFRs-- the Temporary Flight Restrictions. There are some that are unpublished. So over stadiums or over football games, sometimes you won't see those published in advance. But in general, it's a good idea to be aware when you're going over a stadium not to be too low over it. There are a lot of different resources to dive in. We already talked about Sky Vector. There are a bunch of different options here.

And we're seeing that going around. Just so I can see where it is, who has the iPad? Oh, that made its way pretty far. And then the sectional I see over there. So we'll keep it passing around all afternoon.

So just a couple practice questions to keep us on our toes, which statement about longitude and latitude is true?

OK, so A, B, or C. Shout it out. B. All right, that's correct. One rule I have, a thumb, that helps me is that you think of longitude versus latitude, which one goes in which direction, latitude is horizontal. And I think of latitude, it sounds like "fatitude" or being fat. And so your horizontal. So anyway, longitude are the vertical lines. So they cross the equator at right angles.

So I'll leave this to somebody that has a sectional or has seen the sectional. Let's see if you can answer this question referring to one of those legends.

AUDIENCE: So another one for latitude is a bunch of ladders. It sounds like a ladder.

TINA SRIVASTAVA: Oh, that's great. So in the back, we got know another way of remembering latitude. So you said latitude sounds like a ladder. So it looks like steps of a ladder. So that's why they're horizontal. That's a great idea. Thanks.

AUDIENCE: Also, longitude goes the long way around. Latitude, at the poles, is shorter.

TINA SRIVASTAVA: Yeah, so that was that longitude goes the long way around. Where as latitude, sometimes, especially at the poles, is shorter. Very good ones. Thanks.

So I'll ask, I guess, the 30 or 40 or so of you who have already seen the sectional, to be the ones to guess this one. So A, B, or C? C. All right, good job. Very good.

So these, if you take a look at the legend on those maps, for the rest of you, as it comes

around, it should be more clear.