



# ABM

ARDMS Topic:  
Imaging Principles & Instrumentation

Unit 11:  
Modes

Sononerds Ultrasound Physics  
Workbook & Lectures

# Unit 11: Modes

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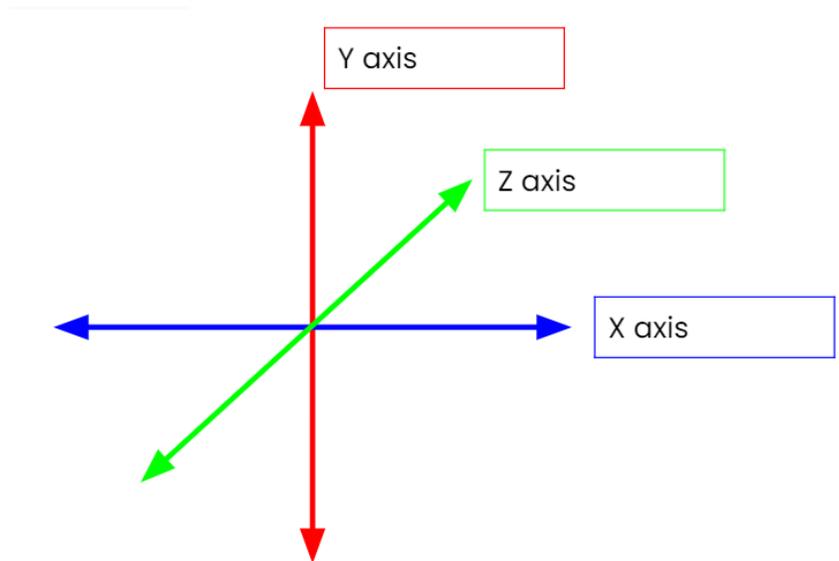
# Unit 11: Modes

## Entire Unit 11 Lecture:

Did you know you can time jump to each section by using the “chapters” in the YouTube video playbar OR timestamps in the video description?

# Unit 11: Modes

Way back in unit 1, we talked about how the graph looks:



The Y axis is the vertical line, the X axis the horizontal line and the z axis a depth line, which creates the 3D world.

The concept of the graph is important as we think about the different ultrasound display modes. An ultrasound display mode is the way that the machine interprets and displays ultrasound information on the screen. Each mode has its own purpose.

There are three display modes:

- **Amplitude Mode (A-mode)**
- **Brightness Mode (B-mode)**
- **Motion Mode (M-mode)**

Each of these modes is represented by two variables that are mapped onto a graph.

For this unit, pay attention to:

- How each mode appears on the display
- The variables and which axis they are represented by

# Section 11.1 A - Mode

→ The "A" in A-mode stands for **AMPLITUDE**

In A-mode, the machine displays a graph that has a spiked appearance. Each moment on that graph represents the amplitude or strength of the returning echo. Tall spikes are strong reflectors, short spikes are weak reflectors and no spike is no reflector.

To create the graph, a dot travels on the screen mapping the reflections that are received from **one scan line**. As the scan line receives a strong echo, the dot will trend upward, weaker echoes have lower spikes.

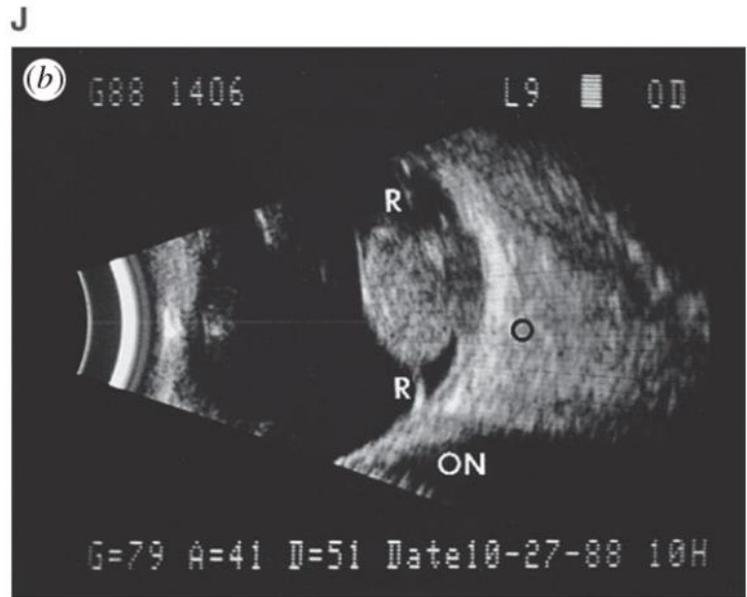
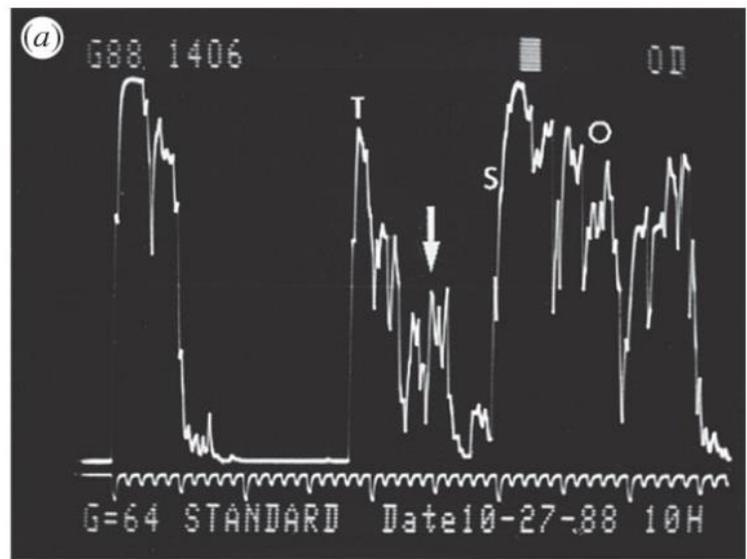


If we could superimpose an image over what A-mode displays, We would see that strong reflectors are bright white, weaker reflectors are shades of gray, and non-reflectors are black (anechoic).

A-mode is often used with ophthalmology practices (eye doctors). By using A-mode, the ophthalmologist can easily see the parts of the eye and any abnormalities within the eye

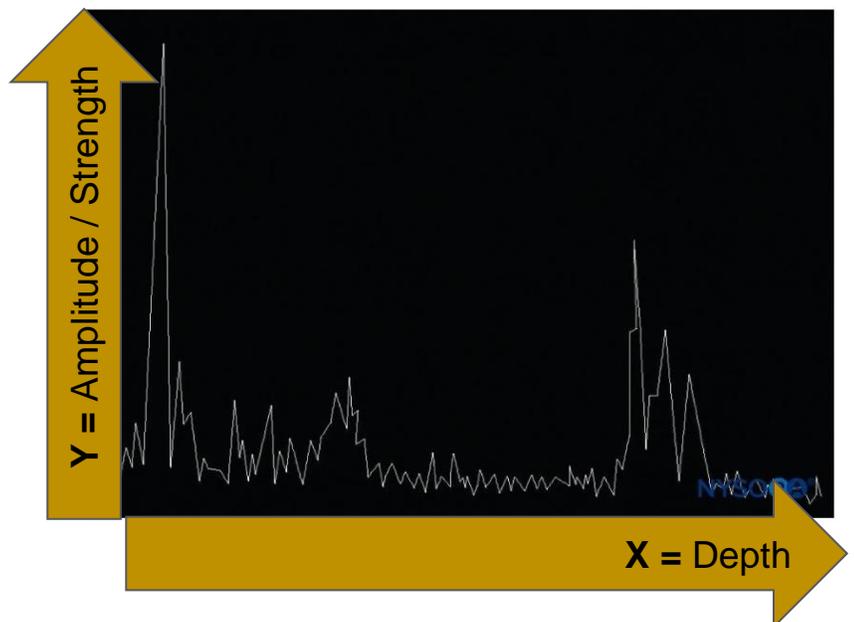
Notice how the tall spikes correspond with the white (strong reflectors) and the low line corresponds with the anechoic fluid in the eye.

Another way to think of A-mode, is to think about how it resembles a city skyline.



→ The X-axis of the A-mode display shows us the time of flight of the pulse or depth.

→ The Y-axis shows us the amplitude (strength) of the reflectors.

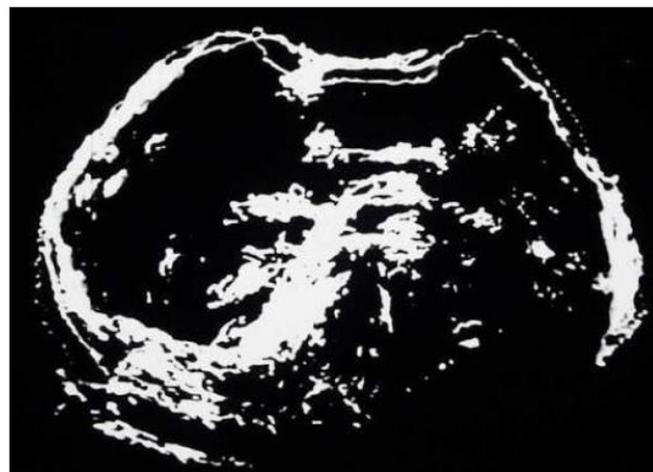
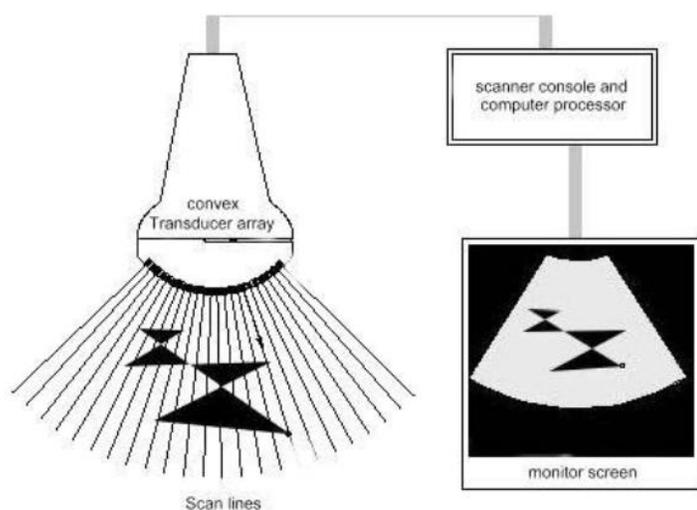


# Section 11.2 B-Mode

→ The “B” in B-mode stands for **BRIGHTNESS**.

B-mode is our “grayscale” mode and the one that is used to make our diagnostic images. The sector (imaging window) that creates our picture is made up of many lines and each line is made up of tiny dots (pixels). The scan line is created from echoes returning from the line.

In original B-mode, the pixel could either be on or off; white or black. Current systems allow for many shades of brightness. White represents strong reflectors and black represents no reflection, with multiple grays in between.



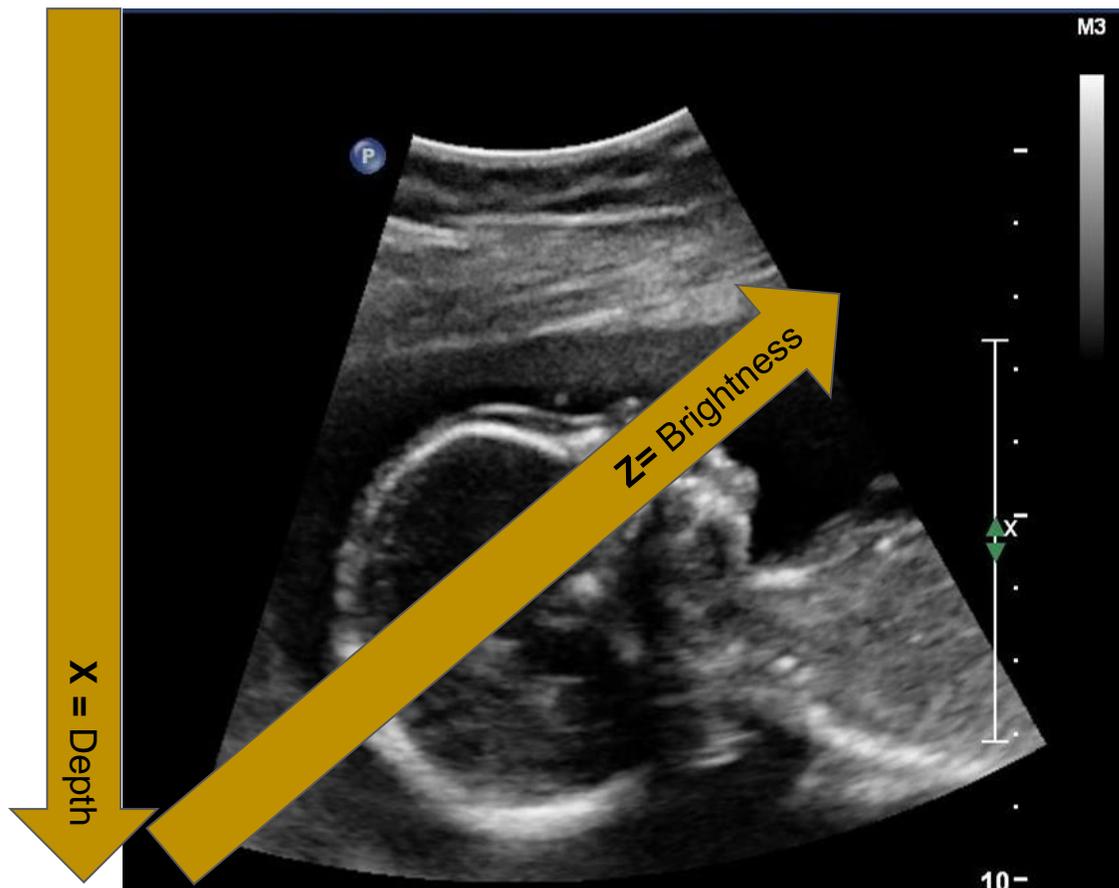
Describing B-mode in the terms of a graph is a little tricky though. We've learned that the Y axis is the vertical line and the X axis is the horizontal line.

So it might be easy to think that in our ultrasound images these lines are Y axis because they are vertical on our screen. In reality, the

- **X axis is the line coming from the transducer**
- **X axis represents depth of the reflector**

I've mentioned oscilloscopes in a previous unit, but recall that these are tools that can graph a wave. If an oscilloscope was used to graph the returning echoes in B-mode, the

- **Amplitude would be graphed on the Z-axis**



# Section 11.3 M-Mode

→ The “M” in M-mode stands for **MOTION**.

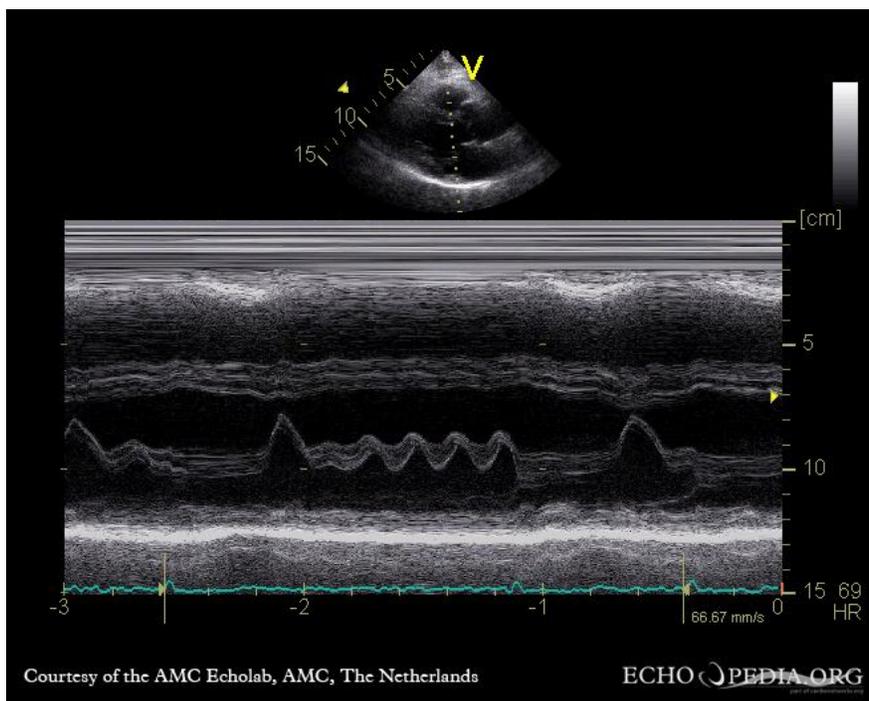
M-mode is used to graph the motion of anatomy over time. It is extremely helpful for many cardiac applications like watching wall motion and measuring ventricle size, just to name a couple. OB/GYN sonographers will use it to evaluate the fetal heart rate and it can be used in emergency medicine to observe lung motion.

M-mode uses **one scan line** to map the motion that is occurring in that line. As the sound beam enters and returns from the body, the machine displays different grays (that correspond with the B-mode image) and is able to do so rapidly, so motion can be seen within the scan line. The sample rate of M-mode is equal to the PRF of the system.

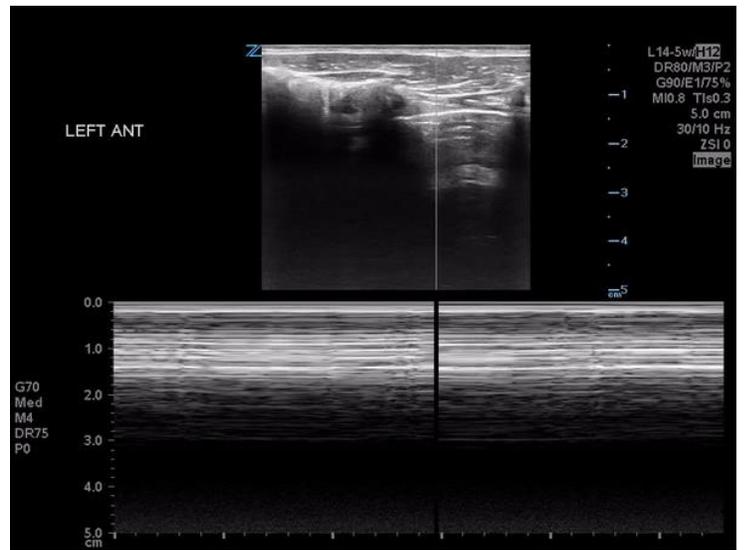
Each pixel in the scan line of the B-mode is recorded over time in the M-mode graph.

- If a pattern of squiggles occurs, that anatomy is moving.
- If a line is horizontal, that shows no motion.
- If an echo is near the top, it is a shallow structure
- If an echo is towards the bottom, it is a deep structure

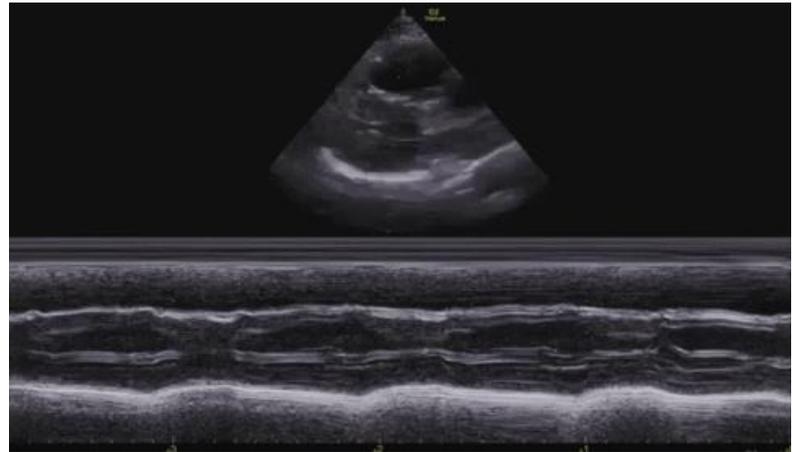
The B-mode image is usually seen above the M-mode image for correlation and correct placement of the M-mode scan line.



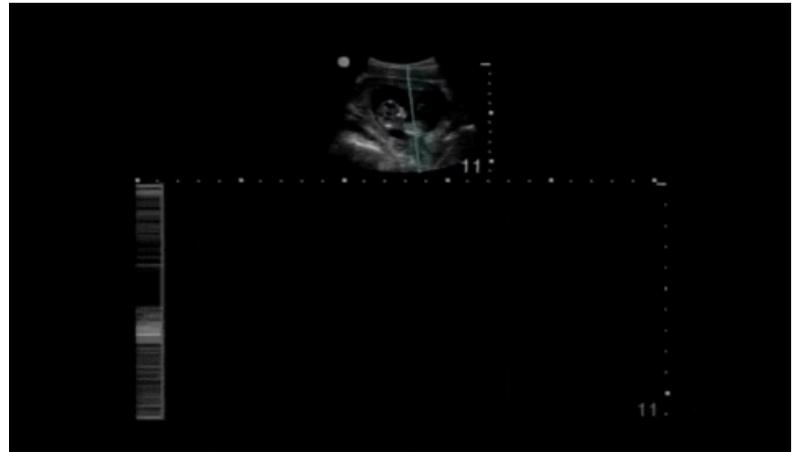
Here is M-mode being used to evaluate lung motion:



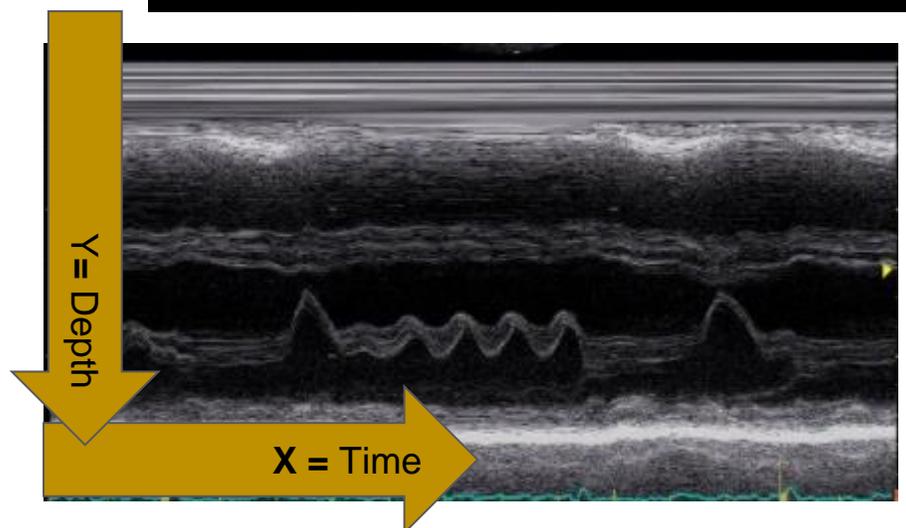
Adult cardiac:



Fetal Cardiac:

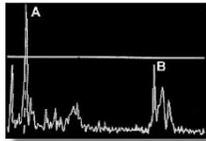
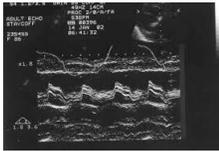


- **Depth is displayed on the Y axis**
- **Time is displayed on the X axis**



# Section 11.4 Activities ← [Link to Answers](#)

In the boxes below, use **A** if the statement is about A-mode, **B** for B-mode and **M** for M-mode.

	This mode resembles a city skyline		If this mode displays a horizontal line, there is no movement
	This mode is equal to the machine's PRF		If this mode displays a horizontal line, there is no reflector
	This mode displays time on the X-axis and depth on the Y-axis		If this mode displays a low level grey, the reflector is weak
	This mode is commonly used in ophthalmology		If this mode displays a tall spike, the reflector is strong
	This mode creates a gray that corresponds to the strength of the echo		This mode displays depth on the X-axis and amplitude on the Z-axis
	This mode use used to create images of anatomy		
	This mode displays depth on the X-axis and amplitude on the Y-axis		
	This mode is the basis for all other imaging types		

# Section 11.5 Nerd Check!

1. What are the three main types of modes that ultrasound can be displayed in?
2. How many scan lines does A mode use?
3. Describe what an A-mode ultrasound looks like.
4. What determines the height of the spike in A-mode?
5. What do strong reflectors look like on A - mode?
6. What do weak reflectors look like on A - mode?
7. What do non- reflectors look like on A - mode?
8. What medical specialty uses A-mode?
9. What is graphed on the x axis in A-mode?
10. What is graphed on the y axis in A-mode?
11. How is B-mode ultrasound used?
12. Describe what an B-mode ultrasound looks like.
13. What determines the brightness of a pixel B-mode?
14. What do strong reflectors look like on B - mode?
15. What do weak reflectors look like on B - mode?
16. What do non- reflectors look like on B - mode?
17. What is graphed on the x axis in B-mode?
18. What is graphed on the z axis in B-mode?
19. How is M-mode ultrasound used?
20. Describe what an M-mode ultrasound looks like.
21. What determines squiggles on an M-mode display?
22. What determines the location on an M-mode display?
23. Where does M-mode get the grayscale "colors" from?
24. What is graphed on the x axis in M-mode?
25. What is graphed on the y axis in M-mode?