

**WEATHER RADAR**

Go to <http://formontana.net> and then click on picture # 72. Look at the image and read the explanation below the image.

1. Use your Montana Highway Map to find Malta. Are there any towns 30 miles south of Malta?
2. What does the little yellow hook-shaped area on the left image tell meteorologists about the way the air is moving within this particular thunderstorm?
3. Explain why RADAR waves can be used to figure out where it is raining, snowing, etc.
4. Look at the diagram on the last page of this handout. If a RADAR wave bounces off of a piece of hail that is being blown toward the RADAR transmitter, how will that wave be different than one that bounces off of a piece of hail that is moving away from the transmitter?
5. Compare the RADAR waves reflecting off of the particles (hail) in the diagram on the last page of this handout. How do the ones with a “lower frequency” compare to the ones with the “higher frequency”?
6. The image on the right (on the web site) shows the same thunderstorm (at the same time) shown on the left. The RADAR device that made these images is located in Billings. What is it about the RADAR waves returning from the little green area that indicates that the winds in that area are moving toward Billings? Circle one.  

They have a higher frequency; their wavelength is shorter.

They have a lower frequency; their wavelength is longer.
7. What is the direction of the winds in the red area relative to the RADAR device in Billings? Circle one.  

The winds in the red area are blowing toward Billings.

The winds in the red area are blowing away from Billings.
8. Under different circumstances this tornado might have been an F-4 or 5. Explain why it was not.

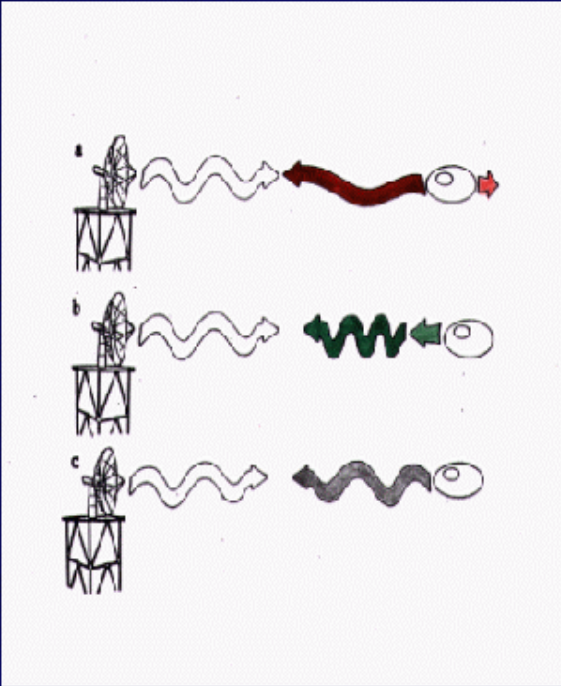
9. Click on the hot Link titled “SATELLITE . . .”. What type of storm was located between the two yellow areas? (The tornado was part of this storm.)
10. Explain what causes this type of storm?
11. Click on the Hot Link titled “Back to the RADAR image of the tornado”. What type of weather event caused the damage to the vehicle shown in the photo?
12. Click on the Hot Link titled “More about hook echoes”. What do the different colors on this image represent? Circle one.
- The different colors show different wind speeds within the storm.
- The different colors show different amounts of precipitation.
13. Which part of the thunderstorm is the tornado located beneath? (northwest, southeast, southwest, or northeast?)

## Doppler Effect

A target moving **AWAY** from the radar returns energy at a **LOWER** frequency

A target moving **TOWARD** the radar returns energy at a **HIGHER** frequency

A **STATIONARY** target returns energy at the **SAME** frequency



The diagram illustrates the Doppler Effect in three scenarios, labeled a, b, and c. Each scenario shows a radar antenna on the left emitting waves towards a target on the right. In scenario a, the target is moving away from the radar, and the reflected waves are shown as a red wave with a longer wavelength. In scenario b, the target is moving toward the radar, and the reflected waves are shown as a green wave with a shorter wavelength. In scenario c, the target is stationary, and the reflected waves are shown as a grey wave with the same wavelength as the emitted waves.

Go back to <http://formontana.net> and select picture # 109.

14. Read the top two paragraphs and then select the phrase “CLICK ON” to compare before and after photos of the Smith Ranch. Why are the buildings labeled with letters?
  
15. The ranch is located 10-15 miles northwest of Medicine Lake. Use your Montana Highway Map to find Medicine Lake. What is the name of the even smaller town located along the railroad tracks about 10 miles north of Medicine Lake?
  
16. Go back to previous web page. Look at the map. Over the past 10 years, which part(s) of Montana have experienced the most tornadoes?
  
17. Why are some of the dots on the map colored red?
  
18. Explain one theory about why there were so many tornadoes in June and July of 2010.
  
19. Select the link titled **The Metra** to see a photo that shows damage from the Fathers’ Day Tornado that hit Billings in June of 2010. You can click on the photo to enlarge it. What part of the Metra sustained the most damage?
  
20. Go back to the previous web page ([www.formontana.net/twisters.html](http://www.formontana.net/twisters.html)). Look at the RADAR image near the bottom of the web page. What was happening in the areas colored pink, white, and red?
  
21. What is it about this image that caused meteorologists who were watching it to be so concerned?