

# Moon Watch

## “The Tides of War”



### MATERIALS AND RESOURCES

None

### ABOUT THIS EXTENSION

This is an extension piece to the “Moon Watch” lesson. It includes an article on the importance of the phase of the Moon and beach tides in planning the D-Day invasion of Normandy during World War II. The article and its higher-level questions provide students an opportunity to apply what they have learned to a historical, real-world scenario in a cross-curricular context.

### OBJECTIVES

Students will:

- Apply what they have learned to a historical, real-world scenario in a cross-curricular context

### LEVEL

Middle Grades: Earth Science

**COMMON CORE STATE STANDARDS****RH.6-8.3**

Identify key steps in a text’s description of a process related to history/social studies (e.g., how a bill becomes law, how interest rates are raised or lowered).

**RH.6-8.8**

Distinguish among fact, opinion, and reasoned judgment in a text.

**ACKNOWLEDGEMENTS**

Ron Cowen, “The Tides of War: D-Day’s Lunar Connection—Moon Phase and Tide Considered in Planning of 1944 Normandy Invasion.” Copyright © 2009 Science Service, Inc., published under license from the Gale Group. Originally published in *Science News*, Vol. 145, No. 23, June 4, 1994. Permission pending. ✕

**ANSWER KEY****QUESTIONS**

- The author’s purpose in writing this article is to discuss the role of astronomy in the planning of the Normandy D-Day invasion.
- The author uses a simile to compare the logs and beams studding the coast to the quills of a porcupine. Physically, the studding of the coast with logs resembles the quills of a porcupine. Functionally, the land mine-tipped logs and beams were protective and defensive in nature, much like the quills of a porcupine.
- Airborne drops had to take place the night before because the paratroopers had to land in darkness but they also needed to see their targets, so there had to be a late-rising Moon. The use of flashlights or any other artificial light would attract the attention of the Germans and reveal their location.
- It should be high in the sky by midnight, when the aerial assault was scheduled to begin.
- The Moon should remain above the horizon until the first light of dawn.
- Ideally, the Moon should be full or nearly so.
- Because the Germans did not have weather stations over the North Atlantic, they were at a tactical disadvantage when predicting meteorological conditions over the English Channel. This fact, combined with the capabilities of the British meteorologists, allowed the Allies to take advantage of a small chance that the weather conditions would improve beginning on June 5 and allow the invasion to proceed as originally planned.
- June 19:  $14 \text{ days} \left( \frac{12^\circ}{1 \text{ day}} \right) = 156^\circ$   
June 21:  $16 \text{ days} \left( \frac{12^\circ}{1 \text{ day}} \right) = 180^\circ$
- During this time, the Moon’s phase will be waning crescent to new moon.
- This would not be a good time to schedule the invasion because the Moon would not provide enough light for the paratroopers to land.



NATIONAL  
MATH + SCIENCE  
INITIATIVE

*D-Day's lunar  
connection—moon  
phase and tide  
considered in  
planning of 1944  
Normandy Invasion*

# Moon Watch

## “The Tides of War”

**B**uffeted by strong winds, they flew across the English Channel late that summer night. At a quarter past midnight on June 6, 1944, British and American commandos parachuted from their planes and landed on the rugged coast of Normandy—territory that Hitler’s army had occupied for the past 4 years. Using flares and radar beacons, this first wave of men marked landing fields, paving the way for other airborne troops to control strategic bridges and road junctions.

D-Day—the beginning of the end of World War II—had begun.

By dawn, some 5,000 ships carrying more than 200,000 soldiers had arrived. Some of these men would drown, others would die in battle. But after months of rehearsal and more than a year of detailed planning, the effort to liberate France was in full swing.

Why June 6? The answer has almost as much to do with astronomy as with military tactics, notes astrophysicist and history buff Bradley E. Schaefer of NASA’s Goddard Space Flight Center in Greenbelt, Md. “People often think of astronomy as an ethereal, academic pursuit of heavenly objects,” he says. “But in times of war, considerations such as the phases of the moon can have a very tangible influence.”

British Prime Minister Winston Churchill had vowed to liberate France ever since June 1940, when the country surrendered to German forces in just 6 weeks and the British suffered a devastating defeat at Dunkirk. In 1942, a strike force of Canadian soldiers came ashore at the port of Dieppe, but the attack proved disastrous. The German army and air force, or Luftwaffe, killed or captured thousands of the invading troops. That experience helped convince General Dwight D. Eisenhower and other Allied leaders that any attack must begin on the beaches rather than in a port town, which the enemy could defend more easily.

That realization was not lost on Field Marshal Erwin Rommel, the German commander of North Africa who spearheaded efforts to fortify defenses along the Atlantic coast. From Cherbourg to Calais, Rommel created a veritable wall of death to greet any Allied troops crossing the English Channel.

Like the quills of a porcupine, massive logs and steel beams tipped with land mines studded the coast. Huge obstacles designed to waylay tanks consumed nearly all the concrete Germany and its occupied territories could produce. Using twisted steel girders known as hedgehogs, metallic devices known as dragons' teeth, tall wooden spikes, and other barriers, Rommel hoped to impale Allied landing craft or blow them to bits. "The war will be won or lost on the beaches," Rommel told an aide.

In the meantime, pressure mounted for the Allied forces to attack. After fighting the Germans in Russia for 3 years without significant help from the United States or Britain, Stalin desperately needed relief—the opening of a second front. After much deliberation, Eisenhower decided he would deploy sometime in June the massive armada that had transformed much of England into an army base. Mindful of the booby-trapped beaches, Eisenhower knew he had to attack at low tide just after dawn, when the full extent of Rommel's deadly Atlantic Wall would be exposed.

(In contrast, says Schaefer, many Allied landings in the Pacific took place at high tide near dawn. High tides typically minimize the strip of exposed land a soldier must cross.)

The need for a low tide on the channel, determined by the moon's tug on the Atlantic, narrowed the choice of invasion dates in June. Conditions would be right on just 6 days that month—June 5 to 7 and June 19 to 21.

<sup>1</sup> and begin by  
midnight

But the Allied forces had a further constraint. The night landings of paratroopers and glider troops, which would precede the dawn attack by ship<sup>1</sup>, required a bright moon. Pilots needed a brightly lit landscape in order to land the troops on target. The soldiers themselves needed light in order to regroup and commandeer bridges and road junctions behind enemy lines.

Only once a month does a low tide at dawn coincide with a bright moon, Schaefer notes. That June, a full moon at low tide would occur on the sixth. The invasion could thus take place on June 5, 6, or 7. Eisenhower chose June 5.

Allied forces set out for the Normandy coast on June 3. But on the following day, one of the worst storms in decades struck the channel. Troops aboard large, heavy vessels fared relatively well. Those on flat-bottomed landing craft, however, were pitched and tossed mercilessly. Water lapped at gunwales, and men became so violently seasick that they threatened to jump overboard.

Eisenhower worried less about the soldiers' nausea than the prospect of cloudy skies. Just as astronomers require clear weather to view the heavens, the troops needed clear skies for an effective air attack. Moreover, the sea had to be calm enough that the surf on the beaches would not hamper the landing craft.

Low tide at dawn wouldn't happen for another 2 weeks, and lunar conditions wouldn't be perfect for another month. Eisenhower feared that if he returned the men to their bases in England, information about where and how the Allies planned to strike would leak to the Germans. On the other hand, an attack during bad weather could spell disaster.

The clouds did have a silver lining, notes Schaefer. On the basis of their meteorological data, the Germans didn't believe an invasion was possible for the next several days. German commanders left their posts to participate in war games inland, and the Luftwaffe was pulled back from the coast. Rommel even left France to visit his family and Hitler in Germany.

But the Germans had no weather stations over the North Atlantic and could not predict conditions over the channel accurately. On the evening of June 4, British meteorologists gave the Allied command an updated report. The scientists reported a chance—a small one—that the weather would clear for about 36 hours, beginning after daybreak on June 5. Conditions that night would still be far less than optimal, but a window of opportunity now existed. Should the Allies risk it? It was up to Eisenhower.

Headquartered on the English coast, he spoke to his staff on June 4: "I am quite positive we must give the order ... I don't like it, but there it is.... I don't see how we can do anything else."

Thus, 50 years ago this week, Eisenhower reset D-Day for June 6.

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**QUESTIONS**

1. What is the author’s purpose in writing this article?
2. The author describes the massive logs and steel beams studding the French Atlantic coast as “[like] quills of a porcupine.” What figure of speech is this? How are the logs and beams similar to the quills of a porcupine?
3. Why was the Moon important to the Allies’ invasion plan? Why would the use of artificial lighting, like flashlights, be dangerous for the paratroopers?
4. To be useful to the Allies, on the night of the invasion by what time should the Moon be high in the sky?
5. To be useful to the Allies, on the night of the invasion until what time should the Moon remain above the horizon?

