



**HEDY
 LAMARR**

Frequency Hopping

Learning Objectives:

- To understand the term frequency when talking about a radio wave;
- To understand how frequency hopping could improve the security of signals passing between a torpedo and a submarine;
- To know that inventors and scientists don't have to look or behave in a certain way to be good at their inventing or science.

Resources:

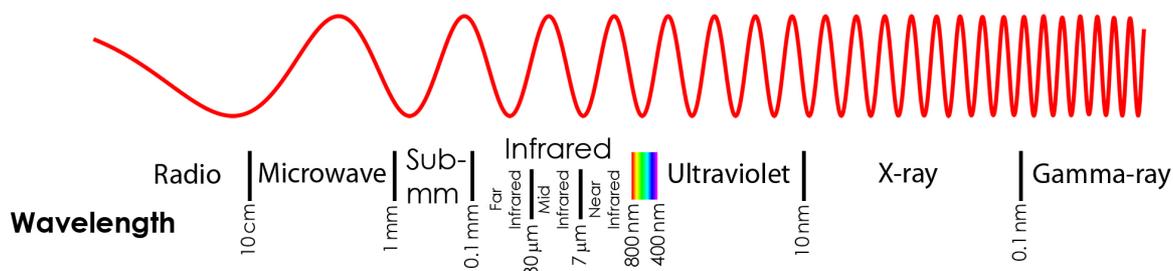
- 'Hedy Lamarr' Powerpoint
- Frequency Hopper Game Boards (one per child)
- Game instructions
- Counters
- Dice (one per group of 4 or one per class)

WHAT YOU SHOULD KNOW BEFORE YOU START

Hedy Lamarr was a film star in the 1940s. Her first film made her famous in 1938 and she continued to be on film and on stage throughout the 40s and 50s. People, at that time, saw her as a beautiful actress. They didn't appreciate that she was extremely clever too. She found that quite frustrating as she wasn't always taken seriously.

World War Two began in Europe in 1939, when Hitler invaded Poland. By 1941, America had entered the war. It was the terrible loss of human life on ships, torpedoed by the Germans, which prompted Hedy to invent something really clever. At the time, she was married to an arms merchant who was often hosting meetings about ammunitions and the war. She listened in and learned about torpedoes and how easy it was to jam their radio frequencies and prevent them from hitting the target.

Hedy had a friend called George Antheil who was a composer. He had composed a piece of music which involved playing music on automated pianos. These 'player pianos' housed a roll of paper with holes punched and a mechanism for playing the notes according to the pattern of holes in the paper. George composed a piece of music which used 16 player pianos, all synchronised perfectly. It was the punched paper holes and the synchronised playing of the pianos which gave Hedy the idea to synchronise the frequency hopping of a radio message, used by the torpedo, so that any frequency blocking by the enemy wouldn't affect the transmission of the radio message as it moved to another frequency.



All the frequencies in the section of the spectrum marked radio can be used to send radio messages. It is quite a wide band of frequencies so there are quite a few different ranges which can be used. When you tune your radio to pick up a radio station, you are detecting radio waves of a certain wavelength. FM radio operates in the range 88-108 MHz (megahertz). Hedy's invention would allow the radio message to skip between 88 different frequencies, so the message would be much harder to block.

Hedy and George patented their idea and gave it to the US Navy who didn't think much of the idea and never used it!

However, we do use a technology like this today in our mobile phones, GPS and other telecommunications as it helps our messages to remain private and to maintain strong clear signals, so Hedy's idea was really ahead of its time.

WARM UP

Show *Slide 1* of the *Hedy Lamarr PowerPoint*.

Ask:

- Which one of these people looks like an inventor?
- Hedy Lamarr lived from 1914 until 2000. Does that help you to work out which picture is Hedy Lamarr? (AVOID USING THE PRONOUN 'HER'.)

Move to *Slide 2* and click through until all the other photos disappear leaving only Hedy and the question, "What were you expecting?"

Tell the children:

Hedy Lamarr was a film star in the 1940s. Her first film made her famous in 1938 and she continued to be on film and on stage throughout the 40s and 50s. People, at that time, saw her as a beautiful actress. They didn't appreciate that she was extremely clever too. She found that quite frustrating as she wasn't always taken seriously.

Ask:

- When you saw the photos, did you think Hedy 'looked like an inventor'?
- Can you tell if someone is clever, just by looking at them?

Tell the children:

World War Two began in Europe in 1939, when Hitler invaded Poland. By 1941, America had entered the war. It was the terrible loss of human life on ships, torpedoed by the Germans, which prompted Hedy to invent something really clever. At the time, she was married to an arms merchant who was often hosting meetings about ammunitions and the war. She listened in and learned about torpedoes and how easy it was to jam their radio frequencies and prevent them from hitting the target.

Watch the following videos:

https://www.youtube.com/watch?v=L-Rn6q4o_ko

https://www.youtube.com/watch?v=6_HxDIbuvA0

Write a moral for Hedy's story. (Something along the lines of 'Never Judge a Book by the Cover' would be appropriate.)

INTRODUCTION

Watch the following video

<https://www.youtube.com/watch?v=LYXUvUVJ3Lw>

Tell the children:

We are going to practise moving our radio message from one frequency to another. We have to synchronise these moves, so you all move on one throw of the dice.

Show *Slide 3*

Tell the children:

All the frequencies in the section of the spectrum marked radio can be used to send radio messages. It is quite a wide band of frequencies so there are quite a few different ranges which can be used. When you tune your radio to pick up a radio station, you are detecting radio waves of a certain wavelength. FM radio operates in the range 88-108 MHz (megahertz). Hedy's invention would allow the radio message to skip between 88 different frequencies, so the message would be much harder to block.

MAIN ACTIVITY

Give each group of up to four children a board to play on and explain the rules.

Choose someone to control the dice and call out the number. This could be done by the teacher, for all groups at the same time, or give each group a die and let them take turns to throw.

The first person to frequency-hop their radio message all the way to the submarine is the winner.

EXTENSION

Give out the blank boards and ask the children to colour in 25 squares. There must be at least 3 squares coloured in each column so they cannot make the game too easy.

REVIEW

All: children will be able to explain that Hedy's invention involved changing a radio signal from one frequency to another to keep a message secret.

Most: children will be able to explain what the word frequency means

Some: children will be able to make their own board for the game which allows for movement by frequency hopping.