

## **1- Thinking visually with an infrared camera**

## **2- Seeing extra-terrestrials**

In the X-files series on Netflix, you can detect aliens with an infrared camera. You see, I also took an extraterrestrial photo with my infrared camera.

That too is fiction.

Reality? The sofa: I sat on the sofa, warmed the sofa with the warmth of my body and got up to take a picture. The heat is detected by the infrared camera.

## **3- Seeing through the roof**

In the Law & Order show, we see officers looking at suspects walking in a house in real time. An helicopter make a lot of noise that would alert the suspects. We can assume then that the real time movie was taken using a drone. Infrared can detect heat up to 1 meter deep. Do you feel comfortable in your house knowing how it is possible to see through it? You can see even better if inside the walls. I'll show you other pictures I took, later.

## **4- Infrared is invisible**

It may be possible to make weapons with the laser and cut the metal, but you can not see them like in movies. The laser, like infrared, is quite invisible. The lightsaber in Star Wars is fiction. The laser waves are quite outside the visible spectrum of light.

## **5- FLIR infrared camera**

There are several models of infrared camera. The FLIR camera that I use attaches to my iPhone or iPad. So, with INFRARED, one must think HEAT. Here we see an image of a heat in motion. You can see the warm air and the surrounding heat. All examples of text and discussion will use the infrared camera.

The infrared camera detects the infrared waves and their intensity. Then, using software, the camera designates a color visible to this infrared wave, depending on the filter chosen by the user. In this way, an image can be obtained that can be seen in the visible spectrum of light.

## **6- Warm blooded, cold blooded, in the middle?**

Write a big headline on this topic that summarizes the headline ... Warm-blooded animals keep their temperature constant, regardless of their environment. Cold-blooded animals retain the same temperature as their environment. Scientists believe however that dinosaurs are in the middle, like sharks. Sharks have cold blood, but their constant movement with use of their muscles warms their bodies. The debate continues, but scientists believe that dinosaurs are in the middle, neither warm-blooded nor cold-blooded (mesotherms).

## **7- Conceptual framework**

The book MAKING THINKING VISIBLE, written by researchers at Harvard University, provides several strategies to encourage discussion and thinking in a school setting. It can be used from kindergarten to secondary.

There are Routines to introduce and explore Ideas You can describe, ask, interpret, question, explain. There are Routines to synthesize and organize Ideas. We make links, raise questions, discuss implications. And there are Routines to go deeper with our Ideas. We can identify the complexities and take different perspectives in our analysis.

## **8- Infrared on the stage**

As in television series, government agents use Infrared and the Zoom in strategy to see what happens on the ground. They make assumptions, revise their assumptions and interpret what they see. They use information to make decisions about the protection and defense of agents, citizens, the country. In the experiment, in a safe place, I set fire to a piece of paper that I placed in a box of apple pie. Only with our eyes, we can not spot the fire, but the infrared camera can spot the intense heat inside the apple pie box.

## 9- Responsibility

Drones cause controversy. Wikileaks revealed first, what happens with the US drones war, responsible for the attacks in Afghanistan. US soldiers use drones from Germany to monitor and attack other countries. Many innocent people were killed that way. In an image of the site of alJazeera, one can see an explosion caused by a drone equipped with a camera Flir.

Who is responsible? ... Are the manufacturers of the camera or drones coming from all over the world? Is it the operators who use drones and who may be making mistakes? This is what the judge thinks in Good Wife who imprisoned a female soldier for an error handling the drone.

In Covert Affairs, the CIA bombed the wrong site. Ah, that's okay, he was a bad guy too. He did not have the luxury of a lawsuit.

Is the US government responsible? President Obama made the decision to send the drones. He also received the Nobel Peace Prize. Or it may be citizens who vote for this government without being sufficiently informed.

In the 100 series, it is indicated that in the future, when the earth is destroyed with nuclear power, it is a drone equipped with an infrared camera that will succeed in locating the survivors. Who is responsible?

## 10- Firefighter drones

In Les Débrouillards or in Science et vie, we could read that the drone and the infrared camera teamed up with the firemen. In dangerous situations such as forest fires or house fires, the infrared camera is essential to see the extent of the fire. It also locates very dangerous places, safer places. And through an intense smoke where the human eye sees nothing, the infrared camera helps the firefighters locate the survivors. The drone can fly over the disaster areas day or night without risking any life since it has no pilot on board. The flight plan is programmed in advance and the drone will follow it.

The infrared camera saves the life of the firefighters by allowing them to see through the smoke and help them out of the fire. There are infrared cameras with every fire crews but firefighters died because he was not the one who had the camera. FLIR works to create low cost cameras so that each firefighter is able to have a camera and reduce loss of life. There are cameras of all prices, the one I use costs about \$ 200.

## **11 - Seeing heat intensity changes**

That thing can see through anything, said the FBI agent of Prison Break. .... Yes and no. Each person or object transmits infrared waves that can be detected. The objects transmit waves according to the Planck equation. The majority of the curve is in the infrared zone. The infrared camera detects the waves that are emitted by the person or object. It's passive. You can see a hand of 3 different colors. The blue fingers are cold, the hand is a little warmer and the arm is the warmest. The yellow chair is warmer, was in the sun while the blue chair is in the shade. The waves as seen in Prison Break are not likely infrared. They may be X-rays.

The film The Mystery of the Invisible World tells us that Infrared is an idea inspired by nature, biomimicry. Several insects are able to see with infrared. The infrared camera is an inspiration from nature.

## **12- Detect people hidden in total darkness**

What do you see or detect?... The suspect thought he was well hidden behind the dark plastic. It was so dark that he could not see himself. Once spotted, the police spoke to him. Get out of there, we see you. You moved your left hand, we see you. Get out.

The infrared camera can detect the person hidden behind the plastic curtain in total darkness. The temperature of a living being is different than the surrounding temperature. Who else could benefit from this technology?

## **13- Science behind the news**

How do the ideas and information presented relate to the information you already have? ... All those who have seen the movie Zero Dark Thirty have noticed that soldiers can see in the dark with the technology of light amplification for night vision. They also know that much effort has been made to find bin Laden. What may not be known is that infrared technology was also used to observe the building where bin Laden lived. In the same way that one can see the heat of the gears inside a clock with the infrared, one can see the movements around and inside a building.

#### **14- Seeing heat loss**

We share, take a break, repeat and discuss ... It is a protocol that ensures that all voices are heard. The houses are not all well insulated. One easily sees the loss of heat with the infrared camera. From inside the house, one can see in dark blue, the place where there is the most loss of heat. The temperature of the inner wall is very different from the outside wall temperature. From the outside, one can see in yellow heat loss, where the brick is the hottest. More insulation is needed. PAUSE

#### **15- House inspection**

You must have heard about the house that exploded in Mississauga last summer. 72 addresses were affected. Before purchasing a house or if you want to know if a house is still in good condition, infrared can help. One can see the temperature of the house, where the air circulates, where there is loss of heat. We can also see the quality of the electrical system. Is it well isolated? Are there any fire hazards? Is there mold under the rugs or in the wall? Is that why my boy is still sick? We see the difference between pipes containing cold water and hot water. With the cold, are the pipes returned to the freezing point? You can see the heating and the air conditioning. Are there any repairs to be made?

#### **16- Visual connection to criminality**

You want a well protected home? The security system in the White Collar program should not be used. One can see the gentle criminal, one of the heroes of the show, commit robberies using the infrared camera. He uses the infrared camera to see which numbers have been pressed to uncover the code and enter the building. In Covert Affairs, the government, the CIA, is looking at the code with an infrared camera.

I tried the experiment. Many dials leave traces of finger heat. The best security systems do not leave any. For example, the keys in the automated teller machines are refrigerated, which keeps each of the keys at the same heat.

At the al-Jazeera site, we see the black man who has committed no crime being condemned to prison and no one pays attention to him. Now I think ...

## **17- Detecting oil spills from an helicopter**

Que voyez-vous? Qu'est-ce qui se passe? Qu'est-ce que vous vous demandez? In the movie Deep Water Horizon we are reminded of the oil spill at the oil platform Deep Water Horizon. It was the largest oil spill in the United States. People aboard the platform needed to be rescued and the oil spill needed to be contained and water cleaned. Where did the petroleum go? How can we protect sea life? Did we collect all petroleum?

Infrared technology can help answer these questions. We have an experiment to prove it. In a dish of water, add vegetable oil and take a picture. It's the same type of photo you can take from a helicopter. One can see in dark blue where the oil is. All areas where oil can be collected should be detected to protect the environment. The picture can be taken during the day or in total darkness.

Another situation: A ship receives a call from another ship stating that it has capsized. The first ship cannot see anything. With his sonar, he sees nothing. So he sends a drone. With the infrared camera on board the drone, he can see that indeed two passenger ships capsized. 15 minutes later, the rescuer was on the scene, rescuing the water passengers. ... Should we always share the observations with the UN?

## **18- Detecting oil spills on the ground**

In accidents, oil spills damage the environment or can cause a fire. It must be cleaned. On the road, firefighters must sprinkle the soil with absorbent material to absorb oil spills. Spilled oil is easy to locate with an infrared camera.

## **19- Operation and rescue**

There is a collapse in a mine after an earthquake. How do you know if there are survivors and how to find them in the dark? Rescuers use the infrared camera in the rubble and can see the miners in the dark moving their arms. The infrared camera is also very useful, every day, to drive in the mines, in the dark, through the dust. With bigger trucks, you need more than mirrors to steer it.

## **20- Pollution detection**

Should natural gas from fracking be adopted? What are the advantages and disadvantages? We have the example of California, where a major gas leak occurred. They managed to clog everything after 16 weeks. Infrared gas leaks could be seen.

## **21- Border security**

Are you worried? Do you need more information or opinions? Any sensitive place may require an additional degree of protection. Infrared surveillance systems can be used at the national level, but also at the private or individual level, if necessary, as in the movie "The Girl with the Dragon Tattoo". The infrared camera does not need light. It sees in total darkness. It saves energy.

## **22- Observing details**

We call it an aspect that we see. It is explained. We give reasons and give an alternative. How can the infrared camera help the police? In addition to seeing people, even at night, with the camera, we can deduce which cars of a parking lot have been used recently. The tires of the cars that have just arrived are red and very hot, as well as the engine. Why did the fugitive escape the police? One of the reasons, because of the snow storm, the helicopters equipped with an infrared camera had to stay on the ground. They were not able to see an overview of the great territory of the mountains.

## **23- Accidents prevention**

There was a collision of 2 cars with a deer. A man is seriously wounded. What is the cause of the accident? Driving while intoxicated? No. Driving on a slippery road? No. Driving distracted? No. Driving with someone exhausted? No. There was a mechanical defect in the car? No. It was simply that the driver had not seen the deer. The head lights did not illuminate enough. Solution? An infrared camera can be attached to an automobile. It allows to see further than with the headlights of the car. This gives the driver more time to react in emergency situations.

## **24- #HourOfCode**

The ISTE technology standards now requires that every student learn how to code. During Hour of Code, in December, it is a good opportunity to introduce students to coding for one hour. With coding, instead of being users of technology, students can become innovative designers of new technology. Hour of Code ignites curiosity towards a well paid and much needed profession.

The movie arrival shows extra-terrestrials coming to Earth. A linguist and a mathematician try to communicate with the extra-terrestrials. We see as well the army using a radar to survey the area. During hour of code, we can use infrared pictures to write the code to simulate a radar, all this in one hour.

## **25- Finding treasures**

Using a satellite equipped with an infrared camera, scientist Sarah Parkak studied Egyptian soil. Since infrared can detect heat up to one meter below the ground, she thought of finding objects buried for thousands of years. Indeed, looking at the details, from the Egyptian soil, she noticed small changes in color. It was only by going on the ground that these discoveries could be confirmed. She found pyramids still unknown which were under the ground. She found ancient cities still unexplored. She thinks there are more Egyptian treasures buried than there are any that we know.

## **26- Seeing space**

What makes you perplexed about space? ..... .. Astronomers in Chile use their telescope with a 570 megapixel camera and 62 network scanners to see the red and infrared light that allows taking the photo of distant galaxies. They took a picture of a galaxy 60 million light-years away from Earth. ESA, the European Space Agency, built the first infrared observatory, located in space. It took 30,000 different observations that need to be analyzed. These data allow us to see, in addition, that the galaxies move away from each other, and that the universe is expanding. The image you see of the new discovery of gravitational waves, although well colored, is a simulation and not an infrared photo. It uses a different technology.



## **27 – James Webb Space Telescope**

Billions (with a B) of dollars have been spent on this. It is the telescope that ATE astronomy. If we want to know how galaxies form, we need to look far away.

Light travels at a fixed speed. If light took 100 years to get to you, you are looking into the past of 100 years ago. If we want to see how the universe formed, we need to see the light from billions of years ago.

At present day, we are 13.8 billion years after the Big Bang. Ground telescopes allow us to see up to 6 billion years after the big bang. The current Hubble space telescope allows us to see up to 482 million years in the past.

James Webb will be launched in October 2018 by NASA. It will be our most powerful telescope. With James Webb, we will be able to see up to 200 million years after the Big Bang. This can only be done with infrared.

The Webb will use infrared light to study every phase in cosmic history, from the first moments after the Big Bang, to exoplanets, to the evolution of our own Solar System. James Webb will search for the earliest stars and galaxies, map the evolution of galaxies, study the formation of stars and planets in the Universe today, search for the potential for life in the Universe.

## **28- Solar Eclipse in infrared**

## **29- War to preserve nature**

What does the person care about? ...

Despite all awareness campaigns, there are still poachers who illegally kill rare animals to enjoy and sell their horns on the black market. Several countries are affected, including South Africa. To protect these animals, rangers use the infrared camera to locate poachers and bring them to justice.

### **30- Protecting animals**

There were situations where dogs attacked sheep from a farm during the night. The sheep were killed and others seriously injured. The farmer suffered enormous losses. Dog owners are not always aware of the behavior of their pet. A police patrol uses the infrared camera to find the dogs that attacked the animals. Other troops of wildlife must be protected and patrols of police officers equipped with an infrared camera to locate the dogs near the herds. Here we can see 9 filters of the infrared camera. Each filter allows to see infrared waves in a different way.

### **31- Proof analysis**

Infrared satellite images are used to analyze aircraft explosions. Airplanes and explosions leave traces of heat in the sky. My small camera can detect differences in heat left by an airplane several kilometers away. The US satellite images captured images of an explosion of a Russian aircraft over Egyptian territory. The Egyptian president quickly condemned the ISIL group for this tragedy. The Americans, who saw the infrared image as evidence, said it was an explosion aboard the aircraft. The investigation continues.

### **32- False ideas**

One might think that the image on a site of a science show is perfectly scientific. Not always. One might think that the image of Quirks and Quarks represents an infrared fossil. It's wrong. The site offers two images, without explanation. They want to make us think ... The fossil is no longer alive, so it should have the same temperature as the room. If we look at the image on the right, we realize that the dinosaur has a constant temperature. The variations we see are air around the dinosaur which is heated by the light of the ceiling light.

In the same way, the television series Homeland begins its series with soldiers who find their hero vanished. The technology with the green glasses that see in near darkness is called LIGHT AMPLIFIER. It's not infrared. If there is a photo of light, Light Amplifier will amplify this photon to 100 photons for example. With infrared technology, one can see in total darkness. No light photon is required. One would think that the images seen under filter are infrared. Not necessarily. We see the image of the star with a blue and brown filter. One can see an infrared image of a woman with a similar position. The two images are completely different.

### **33- No racial prejudice**

One sometimes wonders how to take different perspectives on racial prejudice. The infrared camera does not see the color of the skin or the country of origin. It only sees the temperature of the skin. Children of all different races are on the same level.

### **34- Art**

I am sure MI-5 secret service uses infrared cameras in their investigations. The MI-5 movie shows infrared in an art picture at the end of the movie. If you teach art, the infrared camera could become an ideal tool. Because we see the world in a different way, we can express ourselves in a very unique and innovative way. This is another universe to explore.

### **35- Effective integration of technology**

Where is the infrared technology in the SAMR model? If we use it with another tool, like Padlet, the critical discussion is at the highest level, at the Redefinition level. Padlet allows each student to share on a single digital wall, what he thinks using text, images, voice, movie or Internet link.

Also, if you have shy or introverted students, infrared photography is an ideal way to help them talk and see their thoughts.

By using the infrared camera as technology either in image or video, one can make the student's thinking visible. It provides a tool for the student to express himself / herself and to understand another point of view. Infrared allows for a scientific angle to critically discuss current events. The technology offers completely redefined possibilities of a class that only has an array with chalk.