Camera activities 2

What's it all about?

Activities for the second IR camera section of the show. Images are shown in colour.

Previous knowledge/understanding:

1. The IR camera shows how much IR is coming from each direction
2. Differences in IR levels are usually due to radiation of IR / the temperature of objects

Objectives:

1. Practice understanding that the colour is only related to intensity
2. Learn that different materials are transparent/opaque in IR and visible
3. Discover Mylar as reflective to IR

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1. Different behaviours of light

- Switch laptop to showing camera input (in black and white setting)
- Flick through some colour options. Let children choose, else best use iron.
- Optional: note people wearing glasses – they are opaque – visible light goes through, but not IR.
- Optional: look at window glass – it is reflective – visible light passes through, but IR reflects.

Visible and IR can interact differently with materials. This is the principle behind greenhouses. The glass lets near-IR/visible/shortwave light in, the energy from which is absorbed by the plants etc and re-emitted as mid/far-IR which then is unable to escape.

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2. Translucent or Opaque? – 3 volunteers (or other number as appropriate)

Set up:

- Sheets of materials taped to bamboo canes. They can start off resting on top of each other but you will need a space to lay them out for during the demo.

- The red filter from the prism demo.
- Flip up scoreboard.

We know that light behaves differently when it meets different materials. Introduce terms:

1. We know visible light can travel through glass because the light reflecting from that tree [or whatever you can see] is coming through the glass into our eye for us to see it. Glass is *transparent* to visible light.

2. But visible light can't travel through walls. Light from objects the other side of this wall is reflected or absorbed by the wall, so can't get through to reach our eye. The wall is *opaque* to visible light.

3. If you have something like [physical example if you can] then a bit of the light comes through but not very well. That would be called *translucent*.

We also know the colour of the light matters – this filter was transparent to red light, but opaque to the other colours.

So what about infrared light? [KS3 – it has a different wavelength so behaves differently]

Explain you are going to be testing different materials to find out whether IR can travel through them or not. Hold up the materials to show them what you have but be careful not to touch them other than on the top. Tell them if they get it right then they get a point, if not then you get a point.

You need something warm to hide behind each material – ah you people will do. Ok let's have one volunteer for each material [option to use only one if they are few, it is hard to reach the stage, or if it's been hard to get volunteers for previous demos].

Repeat demo with each volunteer (only one up at a time):

- Find out their name
- Let them choose a material (don't touch yet, then touch only on the top)
- Ask them to hold it up in front of them, but be sure not to touch it – leave a gap of about a hand length [nb this is important else their face may heat up the material, making it glow and appear translucent when it is not – but don't mention this because it'll spoil the next demo].

Do the next bit fairly quickly so arms don't get tired (the material is light but their arms are not). If they look tired or you need to count votes, give them a quick rest from holding it up high.

- Ask the audience whether the material is opaque, translucent or transparent to visible light – can they see Fred?
- Ask everyone whether they think the material will be opaque, translucent or transparent to IR. Let the audience call out a bit, *then* ask the volunteer (if they are unsure that's fine – we are going to find out!). If there isn't an obvious answer, then get them to hold up hands and count to find out the most popular answer.
- Take the camera and point it at the volunteer. Ask the audience what they can see on screen – can they see them? How well? Were they right?

  [With Mylar, stand in front so they see your reflection – they may think it is translucent, but then move so that you are not reflecting from the camera's point of view. See if they can work out what's happening, then demo the effect again while explaining it clearly. It's like a mirror – is a mirror opaque to visible light? That is a fun question, but let the volunteer go back to their seat if you're going to discuss it.]
- Recap how many points you and the audience each have so far

If anyone points out heat transfer onto the material, this can be briefly discussed, point out people are not touching the materials, then move on relatively quickly to retain focus on opaque/translucent/transparent.

At the end, if they win on points then you can shower them in glory but be happy you caught them out on item X. If you win then don't let them feel any disappointment - you can use it to show just how unexpectedly IR behaves compared to visible light - obviously they are wonderful and if they were fooled then anyone would be. Let the demo be the winner, not you personally.

3. Silly cardboard trick

Pick up a piece of cardboard (or similarly solid looking material) and rest it on your palm with fingers splayed outwards. Let it rest there, still, flat against your palm and fingers, while you talk.

“What about something like this cardboard then. Do you think IR would go through this?” (Hopefully they all say no). Or if you used cardboard as a material earlier, then you can recap that it is opaque to IR.

Point the camera down at the cardboard (still on your palm) – you will see you hand print clearly. Hopefully they either (i) are really surprised, or (ii) heckle you for cheating.

Tell them cardboard IS opaque to IR, and think out loud about why your palm shape is coming through. There is heat transfer from your hand to some parts of the cardboard. These parts are warmed, meaning they then radiate more IR. It’s not a single IR lightwave travelling from your hand to the camera as you’d get with a transparent material. The original lightwave is absorbed by the opaque cardboard, this warms the cardboard, which then glows out another lightwave which the camera detects.

Demo heat transfer to other objects, eg putting your hand on the wall, bare feet on the cool floor, hot hand on cool jumper. Option to use volunteers here if there is time, or just demo from their seats.

AstroBoost Project

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