

# Photography for Engineering Documentation

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# Goals for these slides

1. Provide an overview of using photographs in design documentation
2. Suggest some techniques suitable for use with smartphone cameras
3. Help you create effective images with a small amount of effort

Video production shares some techniques and conventions with still photography, and adds other complications that are not considered here.

# In a nutshell

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## 1. Choose what to show

- Reduce distractions
- How wide?
  - ▶ Wide view shows context
  - ▶ Close-up view shows detail

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- How wide?
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## 2. Provide good light

- Lots of light
- Soft light is best for documentary photos

**In a nutshell**

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## 3. Be mindful of depth of field

- Arrange important items to be in the same plane.
- Step back and crop if you can.
- Out-of-focus areas are not always bad.

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- Arrange important items to be in the same plane.
- Step back and crop if you can.
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## 4. Hold the camera steady

- Use a tripod if possible, especially in low light
- Set shutter speed and ISO with advanced camera app



# Carefully choose what to show

Ask yourself

1. ***What is the purpose*** of using a photo for documentation?

Would a simple line drawing be more effective?

Would a CAD model be more effective?

2. How should I ***design the image*** — the photo, line drawing, or CAD model — to serve communication goals?

3. What is the ***minimum of visual content*** needed to convey the important information?

Remove distractions

Direct the viewer's attention

# Carefully choose what to show

Ask yourself

1. What is the purpose?
2. How should I design the image?
3. What is the minimum of visual content?

Answering these questions before you start will save time and produce a better result. As with most other engineering work, planning and foresight are beneficial.

***Start with*** a hand sketch as ***a prototype***.

# Example of a non-helpful photo



Figure 8: Manual Testing Apparatus

Does this photo add information not available from the text description?

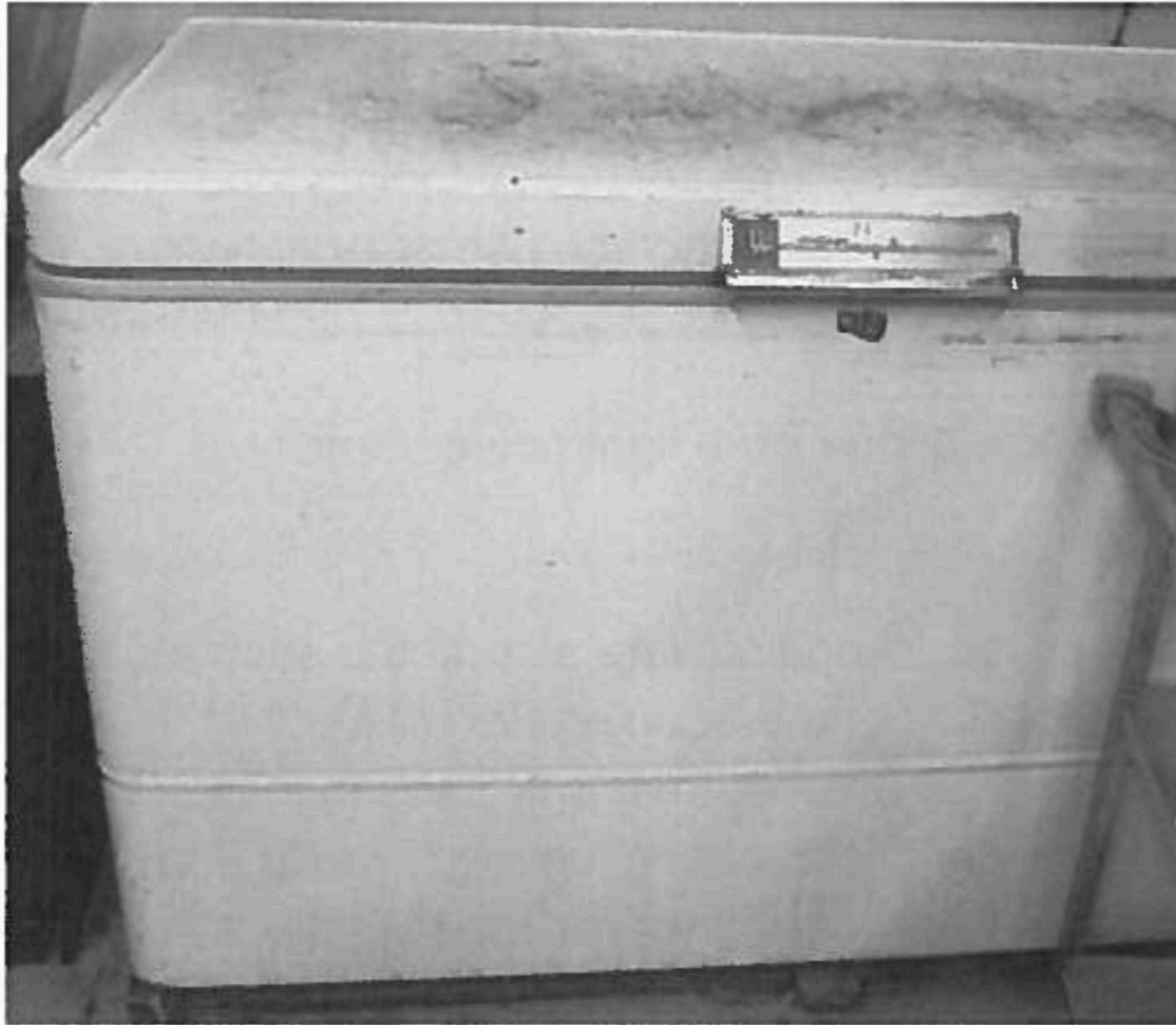


Figure 5: Westinghouse chest freezer located in room 223, one example of outdated refrigeration equipment resulting in energy waste through both power draw and excessive internal heat loads.

Does this photo add information not easily described in words?

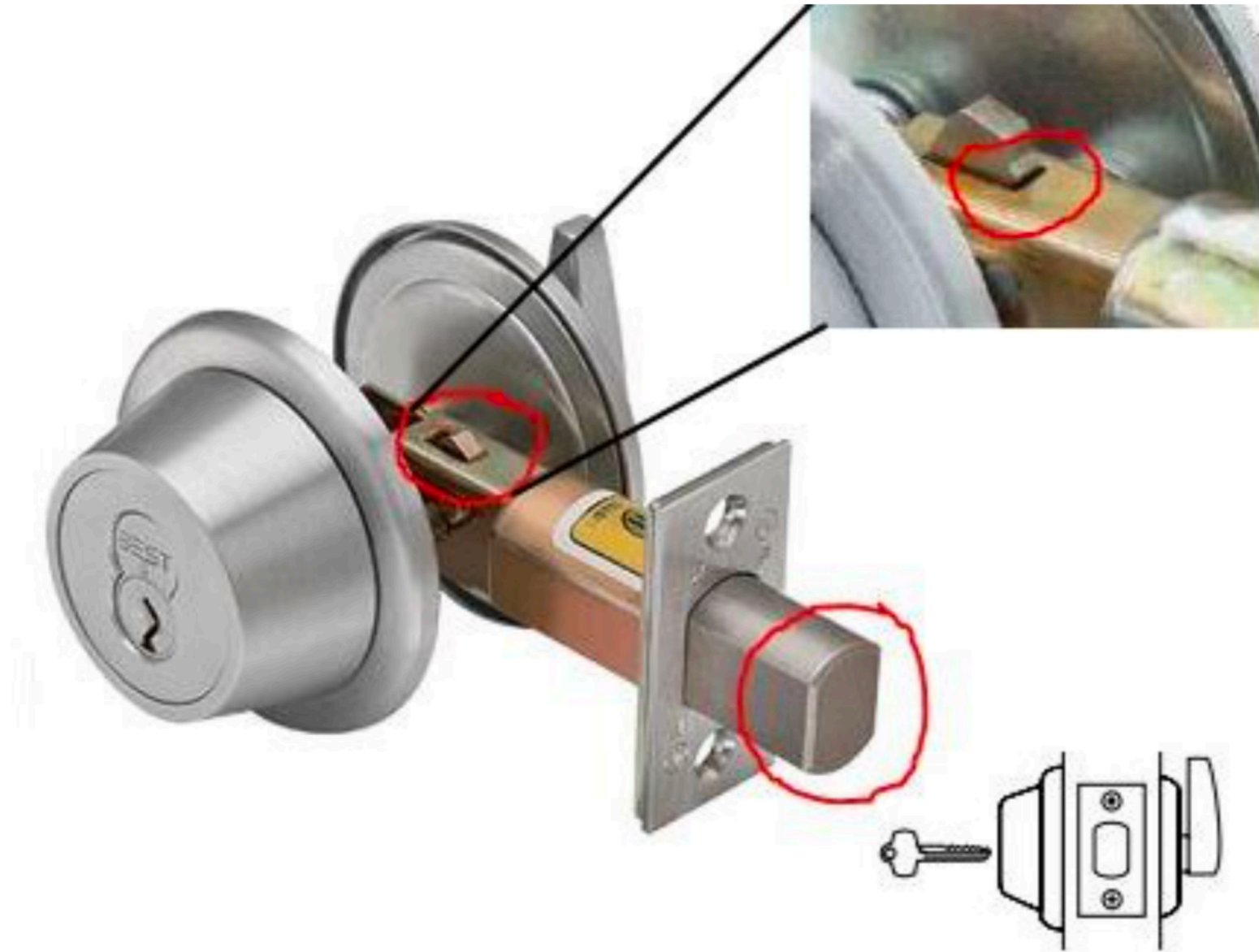


Figure A4: The two areas of modification necessary for the “Modified Deadbolt” design.

# Better use of images

Use images to

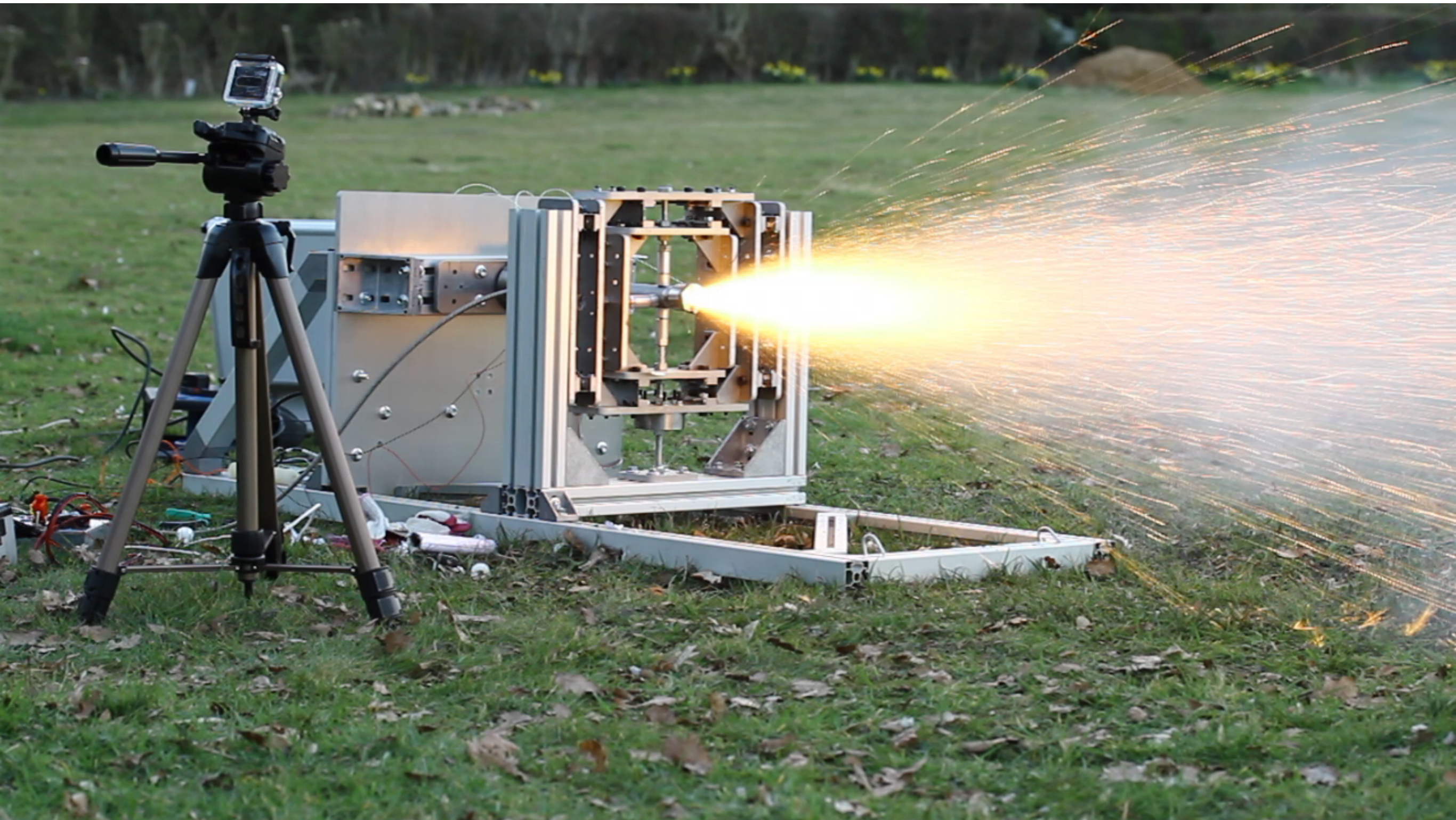
1. Establish context
2. Add explanation to a complex process
3. Show details

# Use an image to establish context



"Matthew Wilcock: Crossrail C510" flickr photo by Engineering at Cambridge <https://flickr.com/photos/cambridgeuniversity-engineering/14480816556> shared under a Creative Commons (BY) license

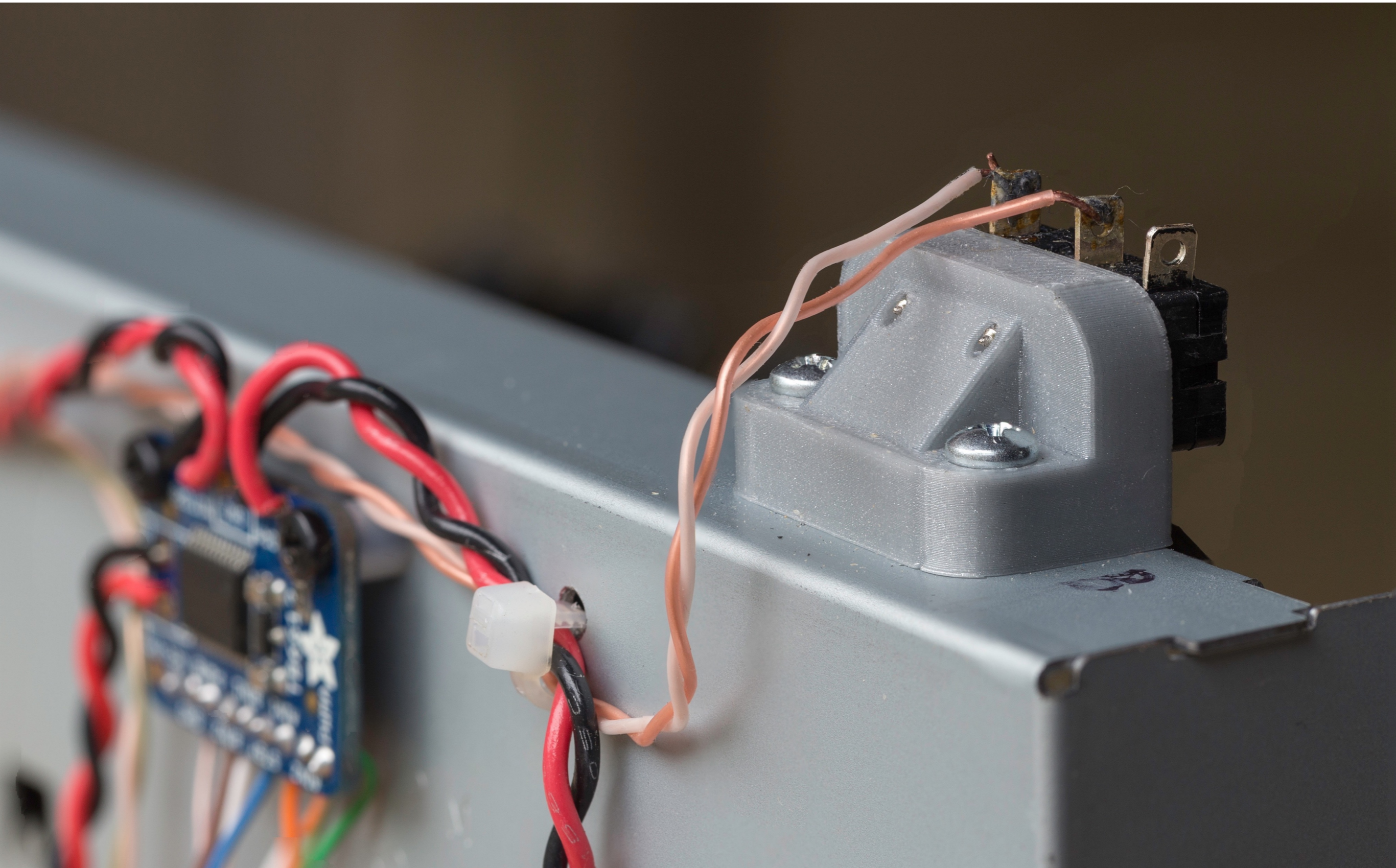
# Use an image to document a procedure



"Andrew Greig: CU Spaceflight Quasar Motor Test" flickr photo by Engineering at Cambridge <https://flickr.com/photos/cambridgeuniversity-engineering/14121591656> shared under a Creative Commons (BY) license



Use an image to show details



# Nomenclature for framing

Film-makers use framing as a visual language to convey meaning with a shot.

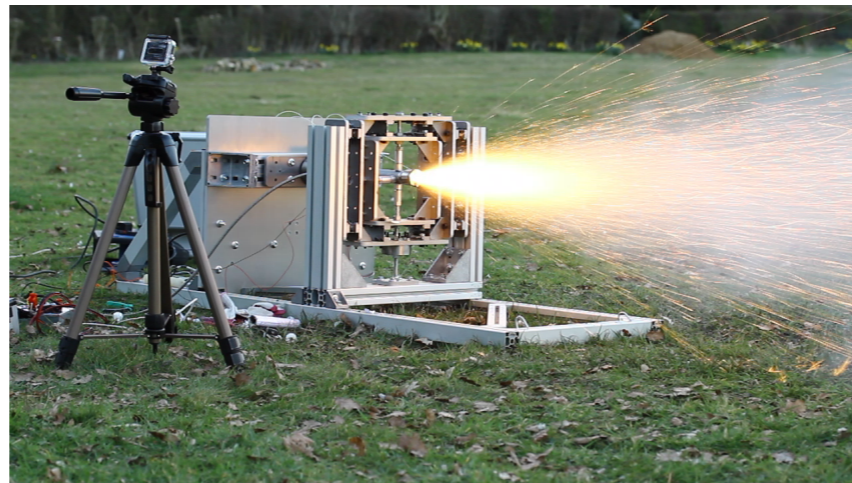
1. An establishing shot or long shot
  - ▶ Shows context: subject located in the environment
  - ▶ Tells the larger story; used for introduction
2. A medium or tight shot
  - ▶ Contains subject with minimum background environment
  - ▶ Shows all the important actors/elements
  - ▶ Avoids distractions and unimportant items
3. Close up or detail
  - ▶ Concentrates viewer attention
  - ▶ Accentuates a crucial detail
  - ▶ May reveal information that cannot be easily expressed in words

# Use framing consistent with purpose

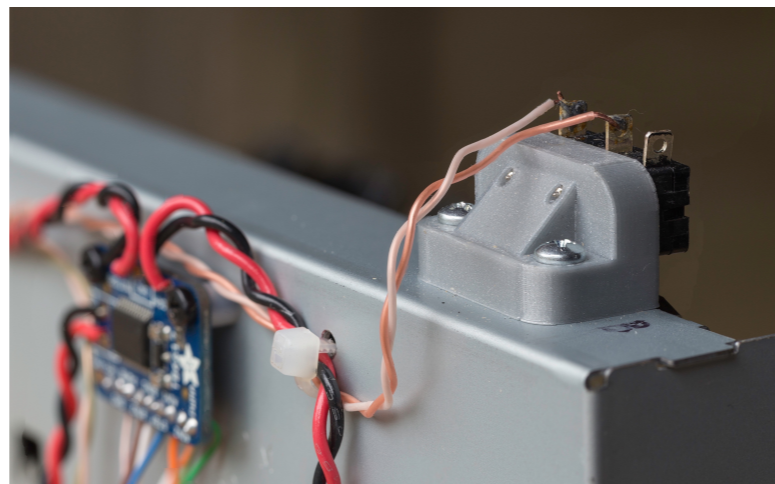
Long



Medium



Close-up

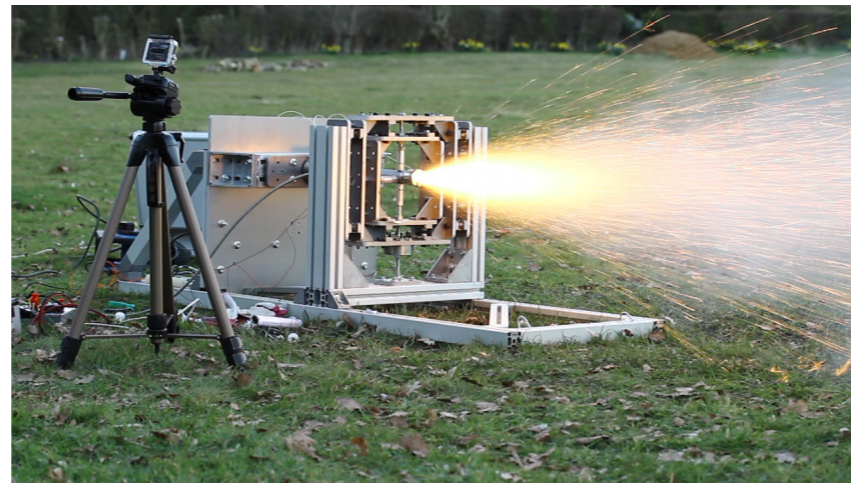


# Use framing consistent with purpose

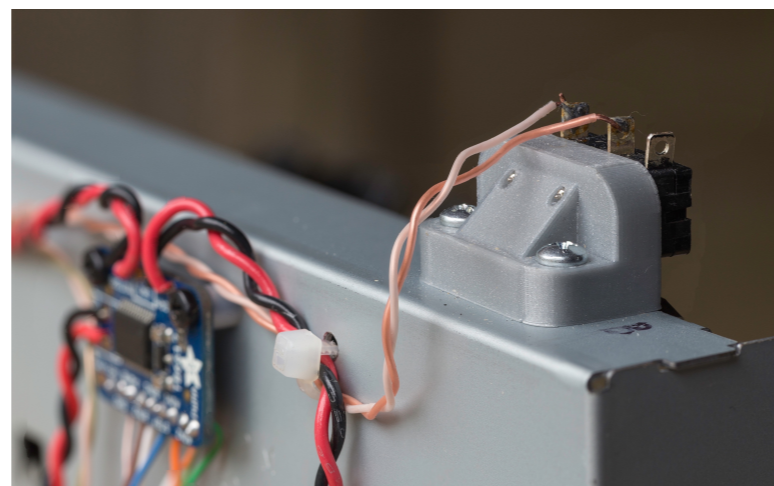
Long



Medium



Close-up



These images have the same height, which was an aesthetic choice. The images were cropped to an appropriate width to eliminate distractions and thereby direct the viewer's attention.

Eliminate distractions

Eliminate distractions  
What is the subject of this photo?



Use plain backgrounds to isolate your subject



Simple props and plain backgrounds are sufficient.  
You don't need a studio. Pick a bright spot in the outdoor shade.





Using your camera as a tool

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Or, if you prefer, use your camera as  
a data collection instrument

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Yes, your mobile phone is good enough

# Physics of cameras

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## 1. Aperture

- Aperture is the size of the diaphragm that allows light through the lens and on to the sensor or film.
- Numerical values of aperture are expressed in “f” or f-stop
  - ▶ Small f value: large aperture → more light, shallow DOF
  - ▶ Large f value: small aperture → less light, larger DOF

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## 3. ISO

- Low ISO: minimal amplification of light signal, good IQ
- High ISO: amplifies light signal in low light, poor IQ

# Specialized camera apps for your phone will give you control over shutter speed and ISO

Mobile phone cameras have fixed aperture, or fixed f.

You can control

- Shutter speed
- ISO (amplification)

In general you want

- Fast shutter speed
- Low ISO

Fast shutter speed and low ISO requires lots of light



Use more light.

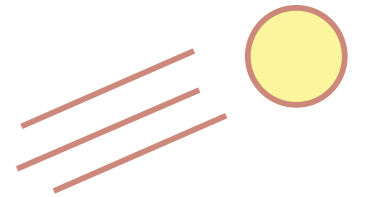
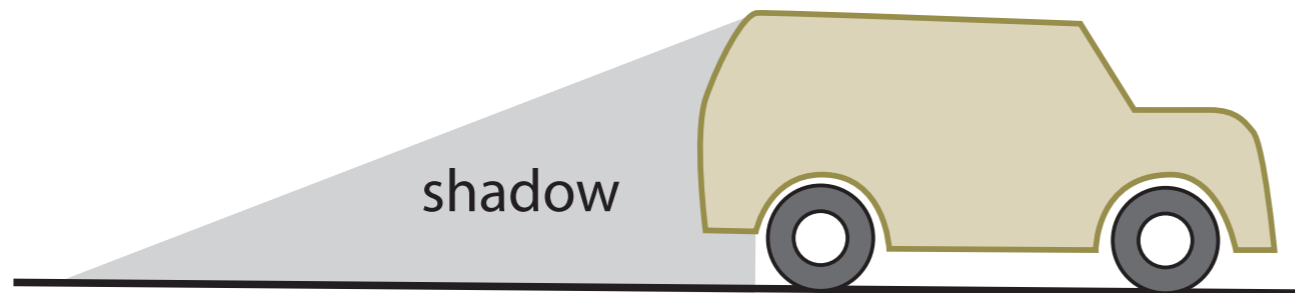
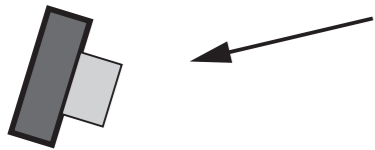
Use soft light.

# Avoid strong backlight



# Avoid strong backlight

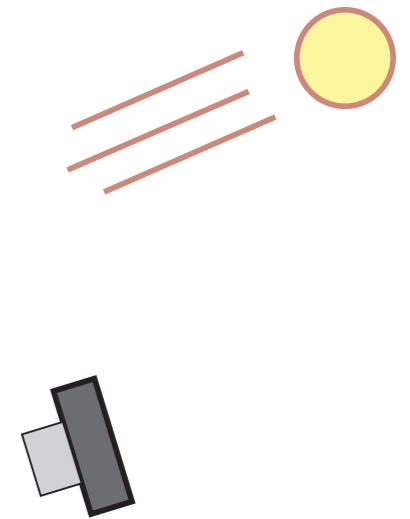
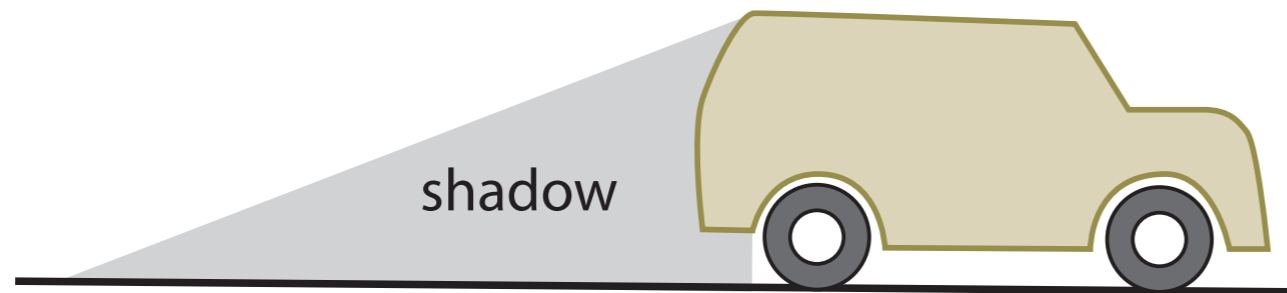
Direct sunlight and illuminated background will dominate the camera's exposure setting



Source of light could be the sun or artificial lights

# Avoid strong direct light

Direct lighting is better than strong backlighting, but it will still cause shadows, and it may cause exposure problems



Source of light could be the sun or artificial lights

Avoid strong direct light



# Avoid strong backlight or direct light



Diffuse lighting is usually best



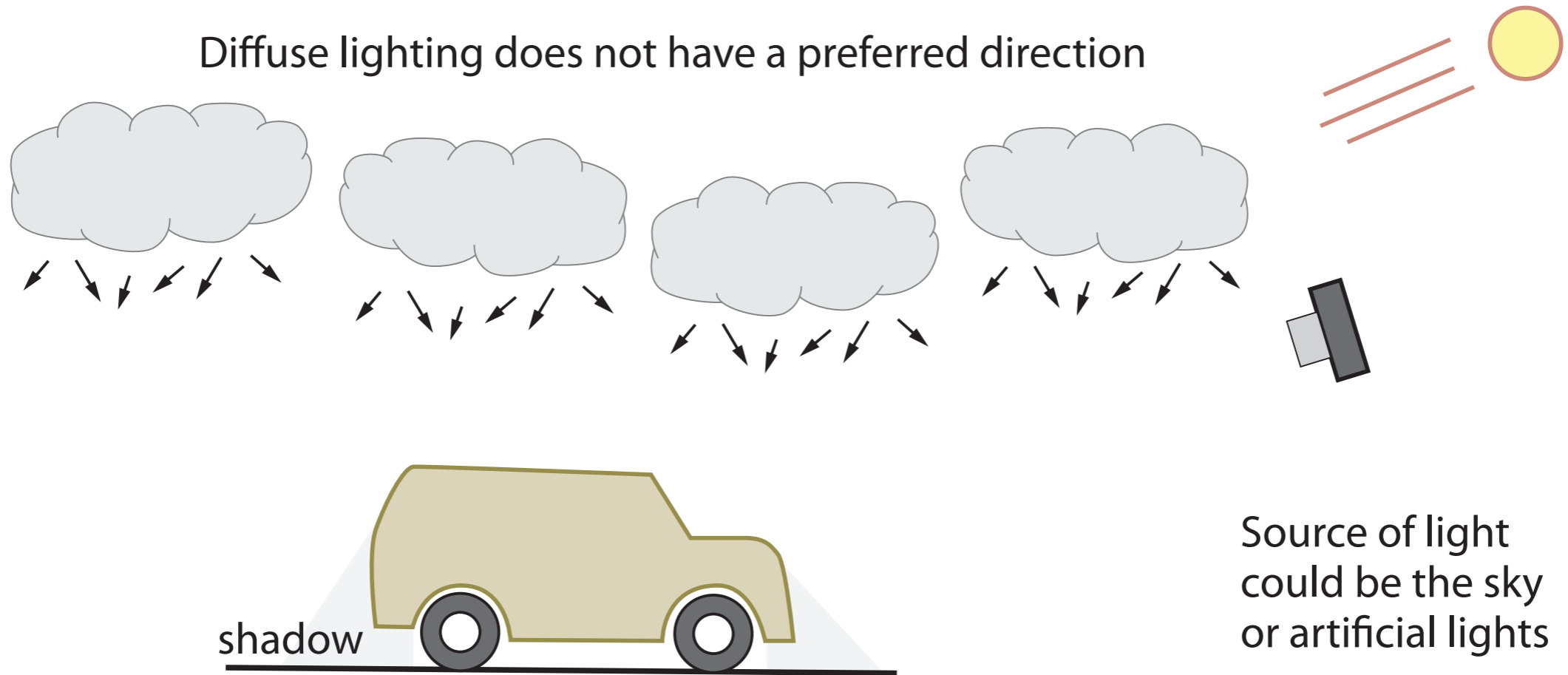
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# Diffuse lighting is usually best

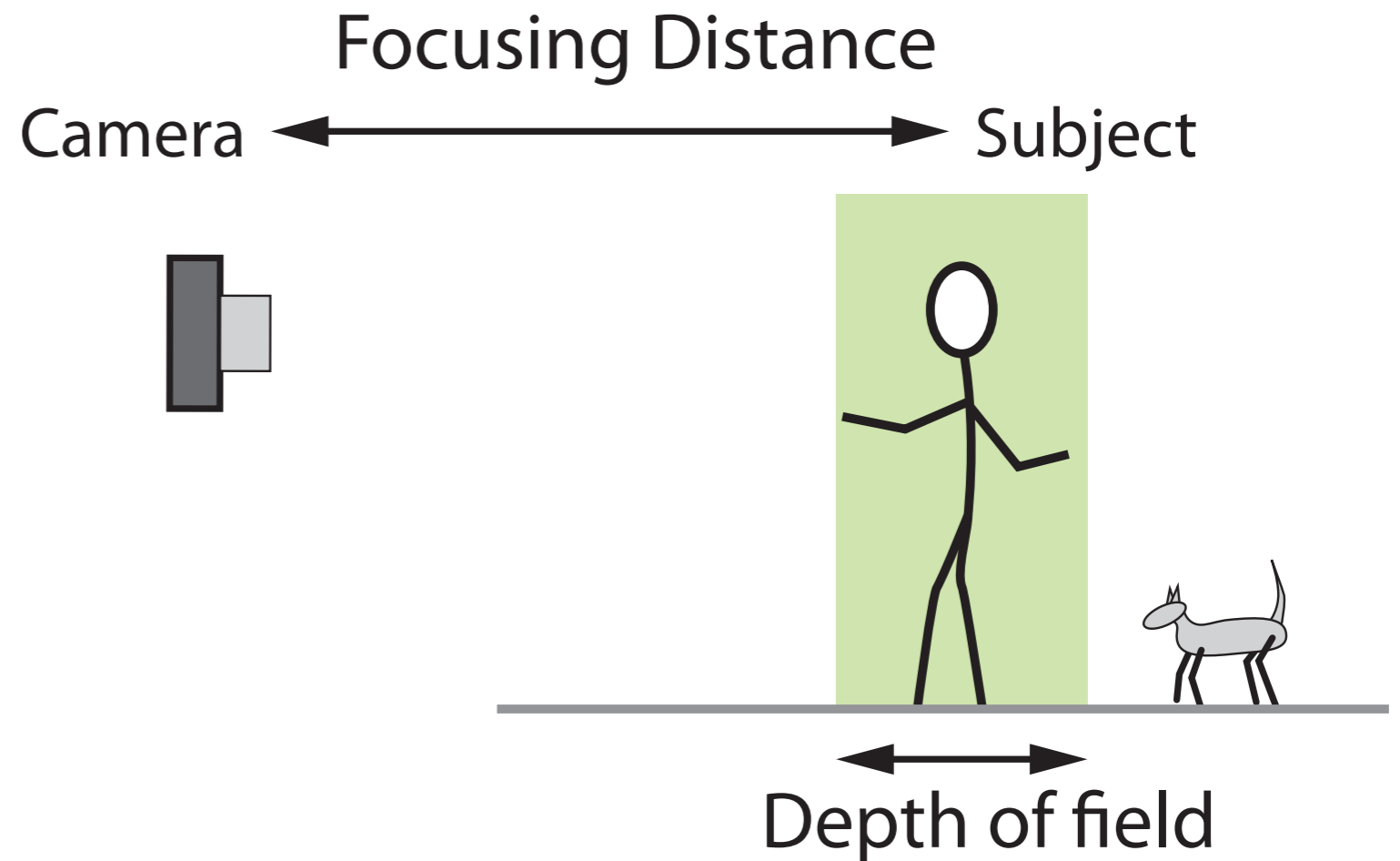
Diffuse lighting does not have a preferred direction



Depth of Field

# Depth of field is the thickness of the space that is in focus

Small aperture lenses have thin depth of field

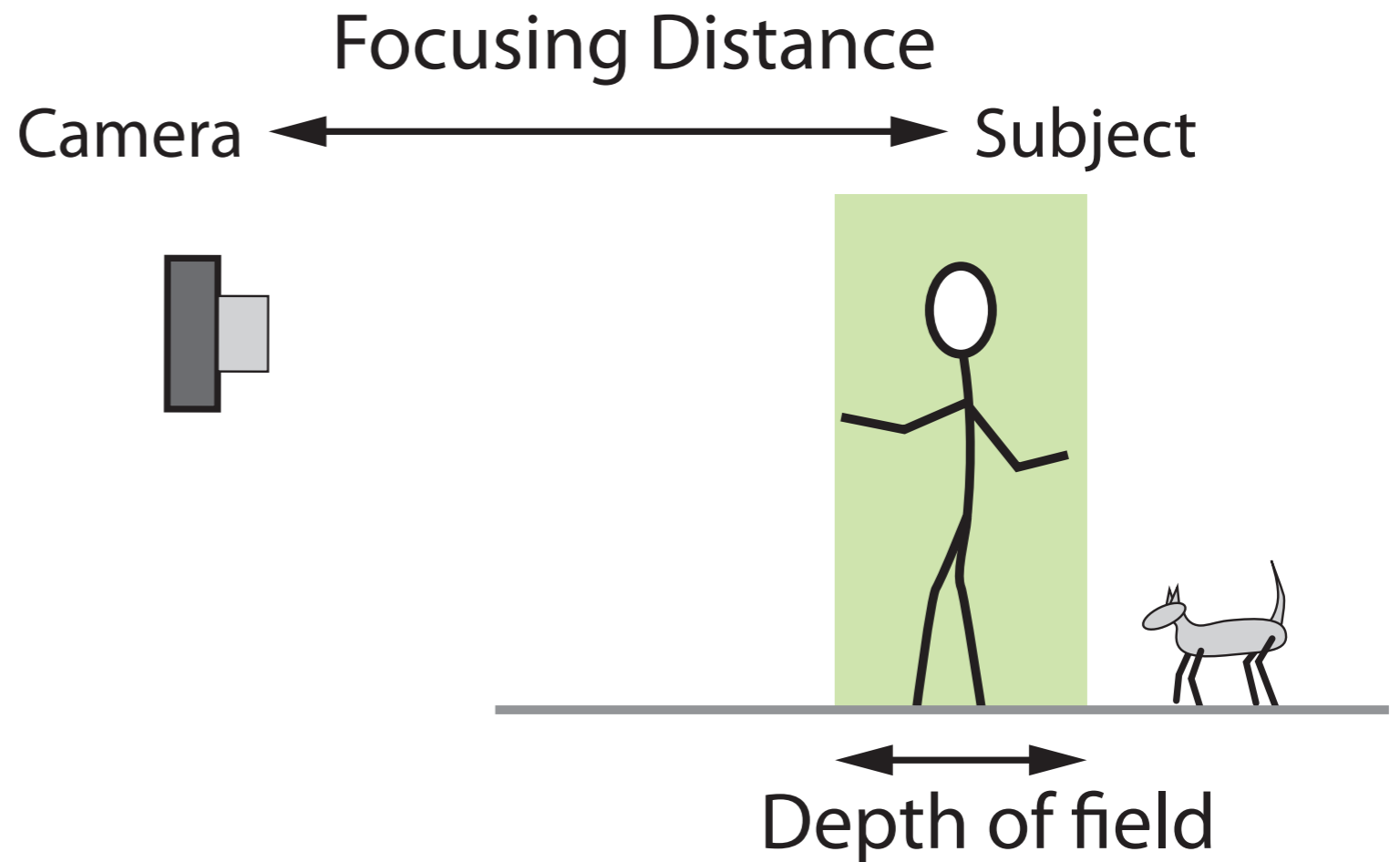


# Depth of field is the thickness of the space that is in focus

Small aperture lenses have thin depth of field

On almost all mobile phones, the aperture is fixed at small  $f$  (1.4 - 2.0).

Therefore, **you can only indirectly control DOF on your mobile phone by changing your focusing distance.**



Technical note: For a given  $f$ , the DOF will also depend on the size of the imaging sensor

Depth of field limits how much of your image is in focus



Depth of field limits how much of your image is in focus



Depth of field limits how much of your image is in focus

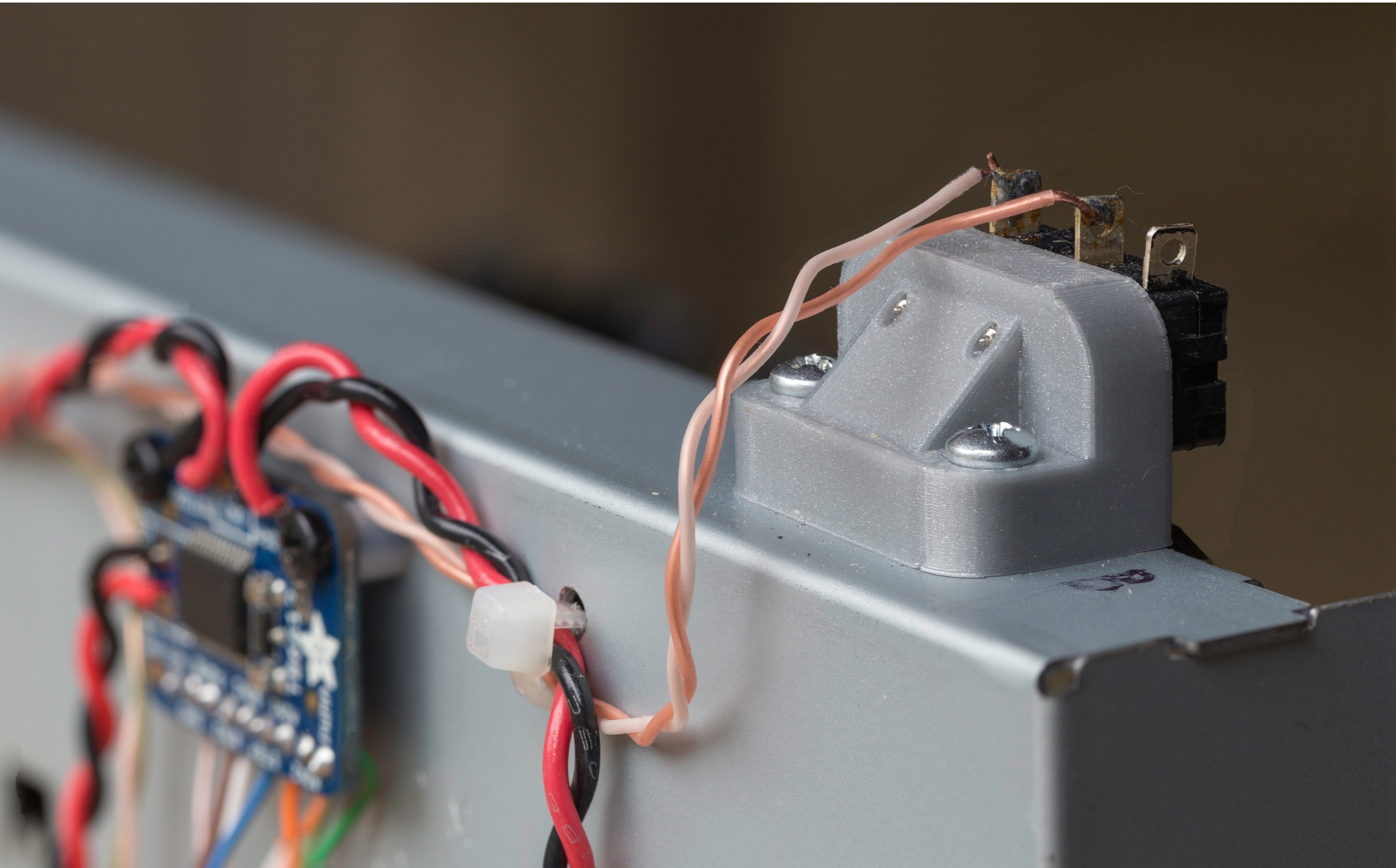


Photo stacking overcomes depth of field limitation.  
15 photos were merged to create this image



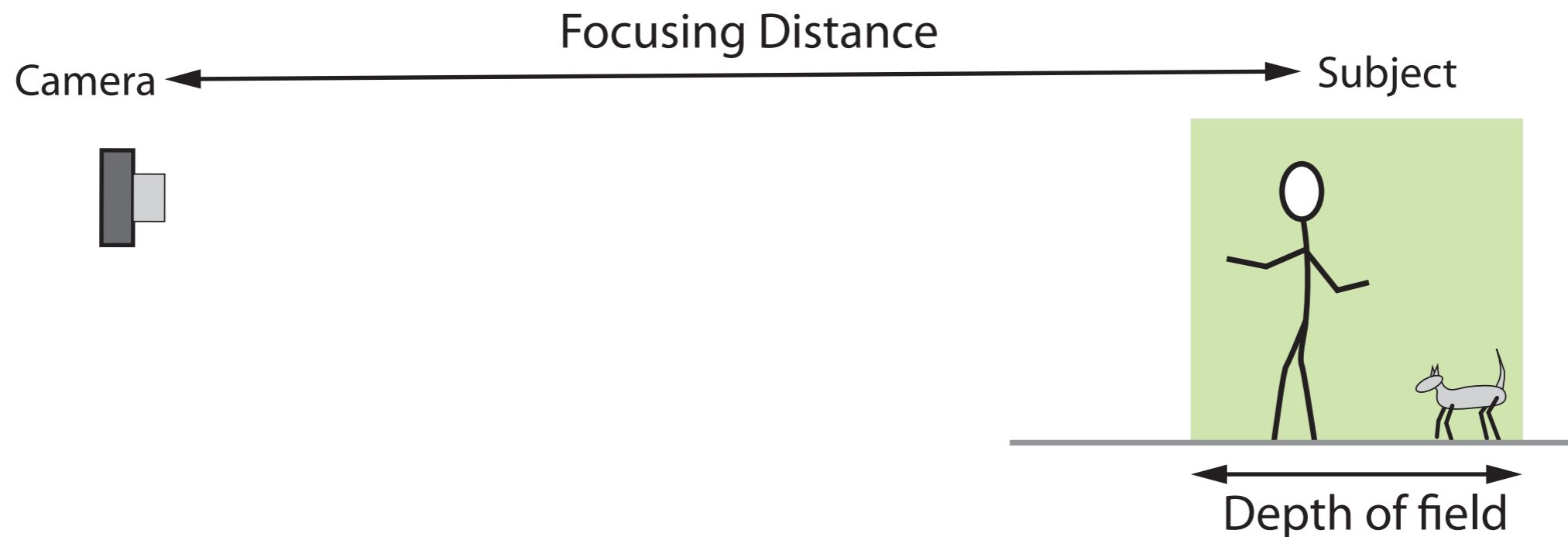
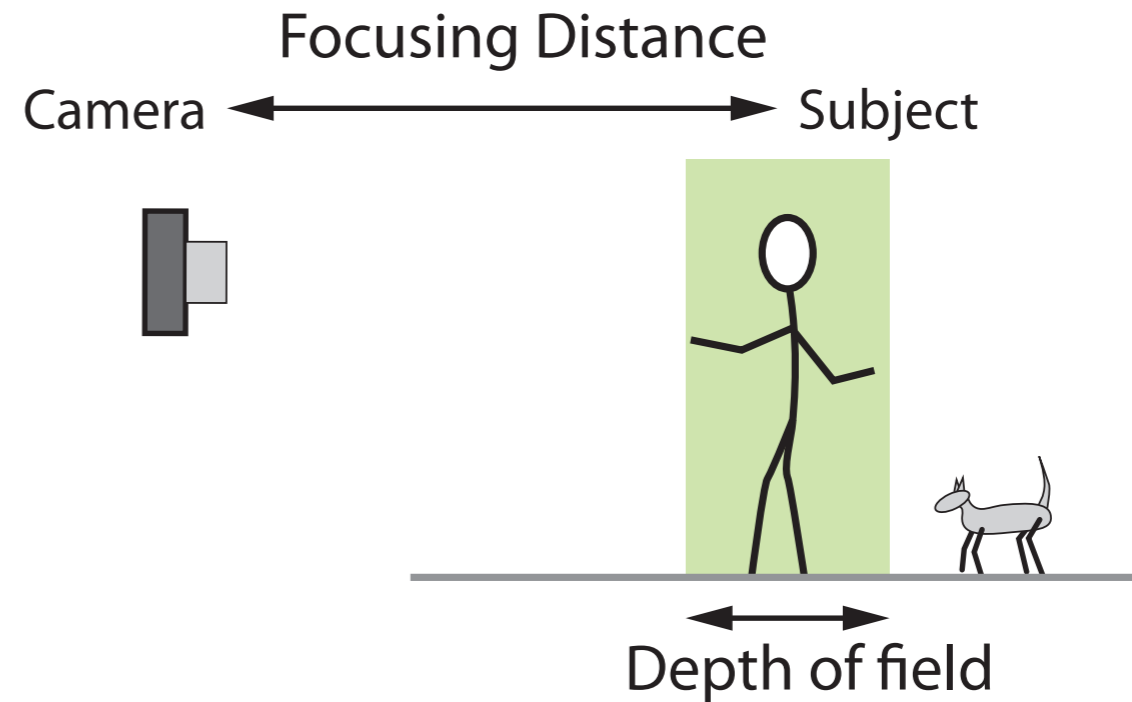


Photo stacking overcomes depth of field limitation.  
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# Compensate for depth of field limitation by stepping back and then cropping

At a fixed aperture, depth of field increases with focusing distance.



# Version 1: Shallow depth of field in close-up



# Version 2: Step back



# Version 2: Step back and crop



Compensate for depth of field limitation by stepping back and then cropping. The benefit is limited by your camera's resolution



Close up



Step back and crop

# Use a tripod at slow shutter speeds



A tripod won't help if your subject is moving.  
To freeze action you need a fast shutter.





# Summary

# You don't need expensive gear

Your mobile phone can take good pictures\*

Paying attention to lighting, composition and good technique can make a big difference.

- Have clarity about the purpose of the image.
- Consider using line art instead of a photo.
- Pay attention to the light.
- Keep your camera steady.
- Keep ISO low and shutter speed high

Take more pictures than you need: Shoot now, edit later

\*Most images in these slides were taken with a 8 megapixel iPhone 5 (released 2012)

# It's not about showing off your technique

1. The purpose is effective communication
2. Don't draw attention to your photos
3. For your final report, engineering content is more important than good photos
4. Don't distract with bad photos

# Checklist

1. What is the purpose of your photo?
  - Choose appropriate width: long/medium/close up.
  - Remove all unessential items from the frame.
  - Sketch a prototype to clarify purpose and plan the photo
2. Be mindful of light
  - More light allows you to create better documentary images: faster shutter speeds and low ISO.
  - Use diffuse light if possible: photograph outside on a cloudy day
3. Be mindful of depth of field
  - Arrange important items to be in the same plane.
  - Step back and crop if you can — technique is limited by camera resolution.
  - Out-of-focus areas are not always bad.
4. Use a tripod or other stable support
  - Tripods allow slower shutter speeds → more light gathering
5. Consider using a dedicated app for photographs on your mobile phone

# In-class Exercise

1. Identify an aspect of your report that would benefit from a photograph. Examples are:
  - Equipment documentation: full scale, close up for detail
  - Process or experimental procedure
2. Identify the location for that photo: indoor, outdoor, in a specific lab
3. Make a prototype sketch.
4. Identify the source of light
5. List equipment needed
  - Camera
  - Plain backdrop: foam core sheets, plywood, roll paper.
  - Tripod and mount
  - Lighting
6. Estimate time commitment
7. Who does it, and when would this photo occur?