Fractions: Slow Motion

Key Learning Content

This film shows how time-lapse and slow-motion photography work. It first explains that film and video images are recorded and played back at 25 frames per second. For slow motion, the photographer must record more than 25 frames per second; to speed events up, the photographer must shoot fewer than 25 frames per second. The precise relationship between speed and frames per second (fps) is one of inverse proportion. This relationship is formally defined and shown graphically. Fractions are then used to calculate the frame rate required for slow-motion images. The method for dividing by a fraction is explained on screen. Familiarity with fraction notation is necessary prior to watching the film.

Core Outcomes

Learning Points

- Be able to understand the concept of a rate of change.
- Be able to multiply and divide an integer by a fraction.
- Be able to understand and use unit fractions as multiplicative inverses.

Suggested Activities

- Calculate the frame rates required for different speeds of slow-motion photography.
- Calculate the frame rates required in order to capture, for example, the course of the Sun in the sky during the day, grass growing in a field, a glacier moving down a mountain side.

Extension Outcomes

Learning Points

- Be able to multiply and divide a fraction by a fraction.
- Be able to understand and interpret direct and inverse proportion.
- Be able to interpret information presented in a range of linear and non-linear graphs.

Suggested Activities

- Practise basic arithmetic skills with fractions.
- Plot a graph of frame rate versus speed of film and use this to calculate frame rates.
- Find and model other examples of inverse proportion relationships.

Slow motion can be used to capture amazing detail, usually unobservable to the naked eye.

Related Films

To use before the lesson plan:

Decimal Places: Photofinish	This film demonstrates the use of freeze-frame to separate first from second place in a race.
Fractions: Pythagorean Tuning	This film shows how finding fractions of a length of string can produce music.

To use after the lesson plan:

Fractional Reserve Banking	This film explores the use of fractions to safeguard the banking system.
Aiming for the Outer Planets	This film gives an example of an application of inverse proportion in outer space.
Histograms: Snapshot	This film looks at the mathematics of taking a good photograph.
Spirals in Nature	This film gives examples of how time-lapse photography is used to speed up change.
The Chase	This film contains an example of slow-motion photography which slows down a chase between a lion and a zebra.

Guide Lesson Plan

Introduction

Search the internet for examples of people who take a photograph of themselves every day, and then at the end of the year post the resulting images as a film on the internet. Explain the 25 frame per second rule and ask how long the film would be if you took one frame a day.

Show Film

Fractions: Slow Motion

Main Activity

Foundation

Go over the theory covered in the film. Tell students that they are TV programme directors covering the Olympics and need to have slow-motion images available for various events. If boxing is half-speed, fencing is quarter-speed, and the 100 metres sprint is one-tenth speed, work out the fps settings you must give to your film crews. Show examples of slow-motion sports footage from the internet and ask students to estimate the relative speeds, and hence frame rates, used.

Main Activity cont ...

Advanced

Go over some examples of calculating the frame rates for slow-motion footage, then extend the theory for dividing an integer by a fraction, to dividing fractions by fractions. Give formal and intuitive explanations of, e.g. why ½ divided by ¼ equals 2. Set practice exercises for multiplication and division of fractions by fractions.

Extension Activity

Foundation

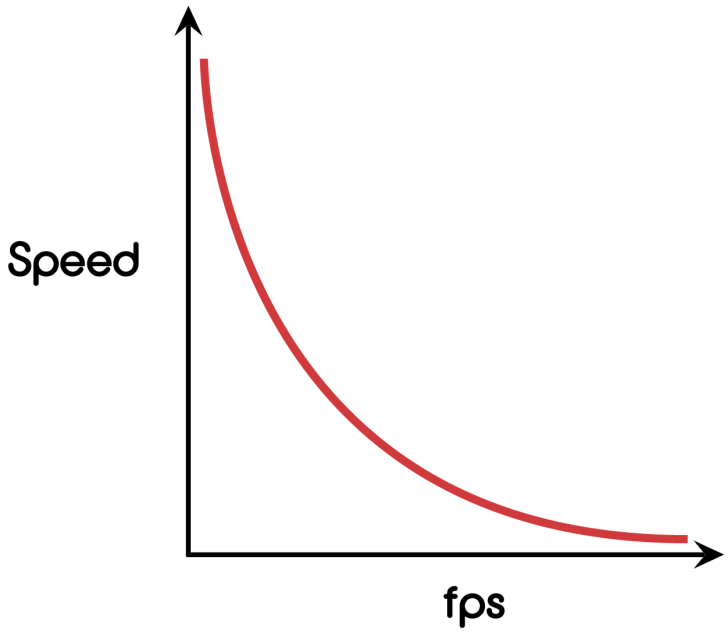
Move on to time-lapse or speeded-up filming, and work through a few examples. Then tell students that they are now required to produce one-minute films of events which take place over a long period of time, e.g. the Sun moving across the sky from dawn to dusk, grass growing in a field, or a glacier moving down a mountain side. Get students to specify the number of frames they need to take, the total period of time to be filmed, and hence the frame rate per second and the speed of the played-back film.

Advanced

Get students to produce a graph for a video camera manual which photographers can use to calculate the frames per second (fps) required for a given playback speed. As shown in the film, plot fps on the x-axis and speed on the y-axis, joining points with a smooth curve. Label the graph clearly for ease of use.

Optional Extra

The relationship between speed and frames per second is a classic inverse proportion relationship. Get students to search the internet to find other examples of the same relationship between real world variables.



This graph shows that the speed of the video image decreases as the frames per second increase.