TAKING AND ANALYZING VIDEO WITH TRACKER
An example of dropping a ball off the 2nd floor of Montezuma Bldg, EMCC

- Taking Video of a ball drop from the 2nd floor of Montezuma Bldg:
    - A regular speed camera is fine (like your phone)
    - Drop the ball from rest
    - Do NOT pan or move the camera with the ball, zoom out to get the entire drop in the shot without moving the camera at all. Keep the camera very still. Don't let it jiggle.
    - Place a small object at a spot on the ground roughly where the ball will hit when it lands
- Preparing the video for analyzing with Tracker:
    - Download video onto laptop computer (send via email)
    - Open up in Quicktime:
        - Trim (through "Edit") the video so it you get just the drop, from just AFTER the ball is released to just BEFORE the ball hits the ground
        - Save the video onto a USB drive or the Desktop (DELETE IT WHEN YOU'RE DONE) as 480p, .mov file extension. Do NOT save as iPhone version .m4v - Tracker won't open it
        - Before closing, go to Window --> Movie Inspector and note the Frame Rate: maybe its ~30fps
- Analyze the Video with Tracker:
    - Open Tracker, either from the Dock (white background icon with pink/purple stars) or from Applications or Launchpad if not there
    - Drag this new clipped file into the Tracker window.
    1. If your video is rotated, go to Video --> Filters --> New --> Rotate and rotate it until the image is upright.
    2. Go to Clip Settings (tiny icon looks like a piece of film reel), and make sure the Frame Rate matches when you got from the Movie Inspector, if not, change it. By using this frame rate, all time intervals will be measured in seconds.
    3. "Create" a new Calibration Stick:
        - **Height from ground to 2nd story @ floor level = 4.72m**
        - Drag the end points so one is at the small object where the ball landed and the other end is directly above it at the floor level of the 2nd floor

- Change the number on the side of the stick to 4.72 (leave off the m, by using this number, all length will be in meters).

- Move the calibration stick to the side, out of the way by clicking and dragging from the middle of the stick (don't change the end points)

- The reason you have to do this is a video is a sequence of pixel data for a sequence of different times: what color the pixel is and where that pixel is, but the image has no idea how big things are in the images. This calibration stick tells Tracker how big a distance a certain number of pixels is. This part can be a source of error for many reasons.

4. "Create" a Point mass:

- Make sure your video clip starts right after the ball is released

- By holding SHIFT, your cursor should turn into a square reticle, if you click in the middle of your object with SHIFT held it will mark the object's location

- The video will advance one frame. So hold SHIFT and click again, marking the object's location at every point in the video, from when it is released until when it hits the ground.

- Not clicking right in the middle, or including before or after the actual ball drop, can be a source of error in the data.

5. Analyzing the data to get the acceleration of gravity:

- Click on the title for the y-axis in the little graph on the right side and change that title to v_y (velocity in the y-direction, down).

- Hold CONTROL and click in the middle of the graph to get a dropdown bar and choose Analyze

- Click the Analyze tab at the top left of the new graph that opens and select Curve Fit

- The default equation it fits your data to is a straight line: $v\_y = A*t + B$

- Acceleration is the slope of velocity in one direction (here it is the y-direction) so you want the value for the fit parameter A, since that is the slope of the fit line.

- Convert this from scientific notation (e.g. 1.13e1 = 1.13x10^1 = 11.3).

- Drop any negative sign (we know its accelerating down) and tack on units of m/s^2 (as long as you did the calibration stick and frame rate correctly, this is correct).

6. What do you get for the acceleration of gravity? We'll look for the class average (or median) and see how off it is.

Quicktime Trim, and Inspect:

  Edit --> "Trim" with Quicktime.

  Save As 480p: mov (not iphone version: m4v)

  To Check Frame Rate: Command + I (mac) or Window --> Show Movie Inspector (commonly 29.97fps)

  Drag saved file icon into Tracker

  If Quicktime codec needed, just try opening directly in Tracker and trimming (**Find beginning and end of clip**).

Tracker – Video Analysis Notes http://www.cabrillo.edu/~dbrown/tracker/help/frameset.html

IT'S IMPORTANT TO USE VERY SHORT VIDEOS. ANALYSIS GOES FASTER. BAD STUFF CAN HAPPEN, OTHERWISE.

Notes:

Saving and Opening Saved Tracker Files:

  Save Tab (.trk) – does save calibration stick and points

  When double-clicking saved .trk file: opens BLANK tracker. Need to still go to OPEN – it's all there.

*Video Types: all these work:

  digital video files (.mov, .avi, .mp4, .flv, .wmv, etc.) which require a **video engine** (see below).

  animated GIF files (.gif).

  image sequences consisting of one or more digital images (.jpg, .png or pasted from the clipboard).

*Image Transformations: (Under video filters)

  Rotate – Go to Video→Filters→New and hopefully the Rotate Filter is there

  There are numerous other filters

*Frame Rate: set this using the Clip Inspector, the image of the film clip on the toolbar

  *Default = 30fps, 240fps common for high speed

*Find beginning and end of clip:

  *Advance through film and set the triangles beneath to denote the beginning and end of clips

**Tracks: a video feature that evolves over time including axes, measuring tools, calibration tools, point masses, etc.

  -To mark a <u>point mass</u>: **Shift+Click** -To mark the same spot if it hasn't moved: (**Shift+?)Enter**

    *The video **automatically steps to next frame** for you, do NOT skip frames!

    *Click the **velocity or acceleration** button in the toolbar (at top not floating) and can apply a **stretch** (two other buttons in toolbar) by arbitrary number or by the mass to **get momentum**!!

  -**Autotracker:** if consistent shape, size, color and orientation in all video frames

  -Track control: this floating toolbar displays a track for each user created track, click the button to see options.

  -Track button of currently selected track is displayed in lower tier of the toolbar: **SET THE MASS**

  -Can also set vectors (vector tracks), useful for the arm of a pendulum. Commonly used for forces in a force diagram. Vectors are solid to distinguish from motion vectors.

    ***Shift+Click** at the TAIL, and drag to where the TIP should go. Can also use Shift+Enter to mark identical vectors next step.

    *Vector sum takes the sum of vector tracks already existing. Also useful in force diagrams (and momentum? This is done automatically for point masses.)

*Coordinate System is the set of transformations that convert the image positions into world positions.

  Components: Scale, Origin, Angle (of axes)

  "Fixed" coordinate system means it doesn't vary from frame to frame

  "Locked" coordinate system prevents any changes to the Scale, Origin, and Angle

Scale: set with a calibration stick or calibration points

Origin: set with the axes, offset origin or calibration points

Angle: set the angle of the x-axis using the axes, calibration stick or calibration points

The following are Tracks affecting the coordinate system → access in Track Menu

*Calibration Stick: Most common tool for setting video scale, if you unfix, it can vary from frame to frame. Lock to prevent changes. Set this to a known scale in the real world and can input and angle which sets the axis angle to be parallel to the calibration stick (correcting for tilt in camera angle).

*Axes – set origin and angle, can be "fixed" or unfixed, may be able to autotrack this

*Calibration points – very powerful, suggest using with calibration stick and axes to see how they work

*Coordinate System → Reference Frame menu lets you set the reference frame including the Center of Mass Reference frame which is set automatically by a set of point masses.

Casio Exilim – High Speed Camera Notes

*Records up to 1000fps, 240fps usually good enough for high speed *Audio records during 30fps ONLY

1. Push Menu,

2. Select "Movie Quality" and press "Set on desired frame rate:

*A fast frame rate will result in a smaller image size

HS 1000 = 1000fps, HS480 = 480fps, HS240 = 240fps, HS120=120fps, HS30-240=30-240fps, HS30-120 = 30-120fps (bigger image size in pixels than previous

3. Record the movie the same way you normally would:

*Press [O] (Movie), a filled circle, to START and STOP recording

*During High Speed recording, the focus is fixed at the position where it was when recording started.

*To focus, half-press the shutter button for Auto Focus or focus manually before you press [O] (Movie)

Different version, similar

1. Align MODE DIAL with [P] (Program Auto)

2. Press [MENU]

3. Press [<], then use [/\] and [\/] to select **"REC MENU",** then press [SET].

4. Use [/\] and [\/] to select **"Movie Quality"** and then press [>]

5. Use [/\] and [\/] to select the frame rate (recording speed) you want and then press [SET]

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6. Record the movie the same way you normally would:

*Press [O] (Movie), a filled circle, to START and STOP recording

*During High Speed recording, the focus is fixed at the position where it was when recording started.

*To focus, half-press the shutter button for Auto Focus or focus manually before you press [O] (Movie)

*Continuous AutoFocus is operational at 30fps with HS30-120 or HS30-240 but becomes fixed when switching to 120 or 240fps.

*To switch recording speeds with HS30-120 or HS30-240, only during filming, press [<] or [>] or [SET] to switch speeds, only 30fps records audio.

*Higher frame rate requires more lighting.