

Sketching Parabolic Arcs

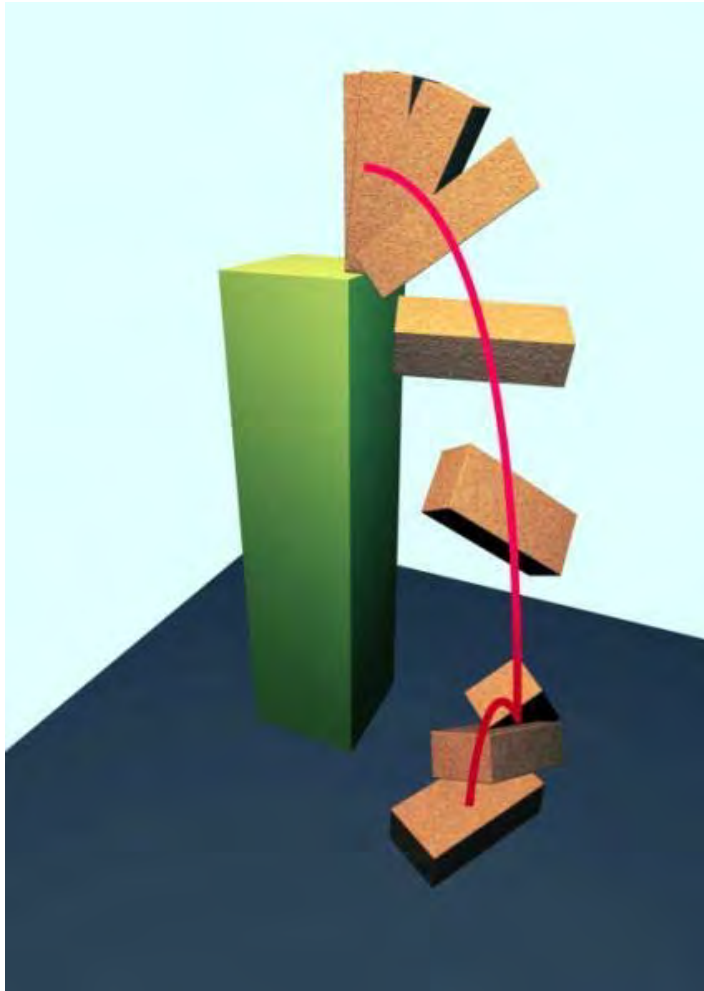


National Science Foundation
WHERE DISCOVERIES BEGIN

Animation
Physics



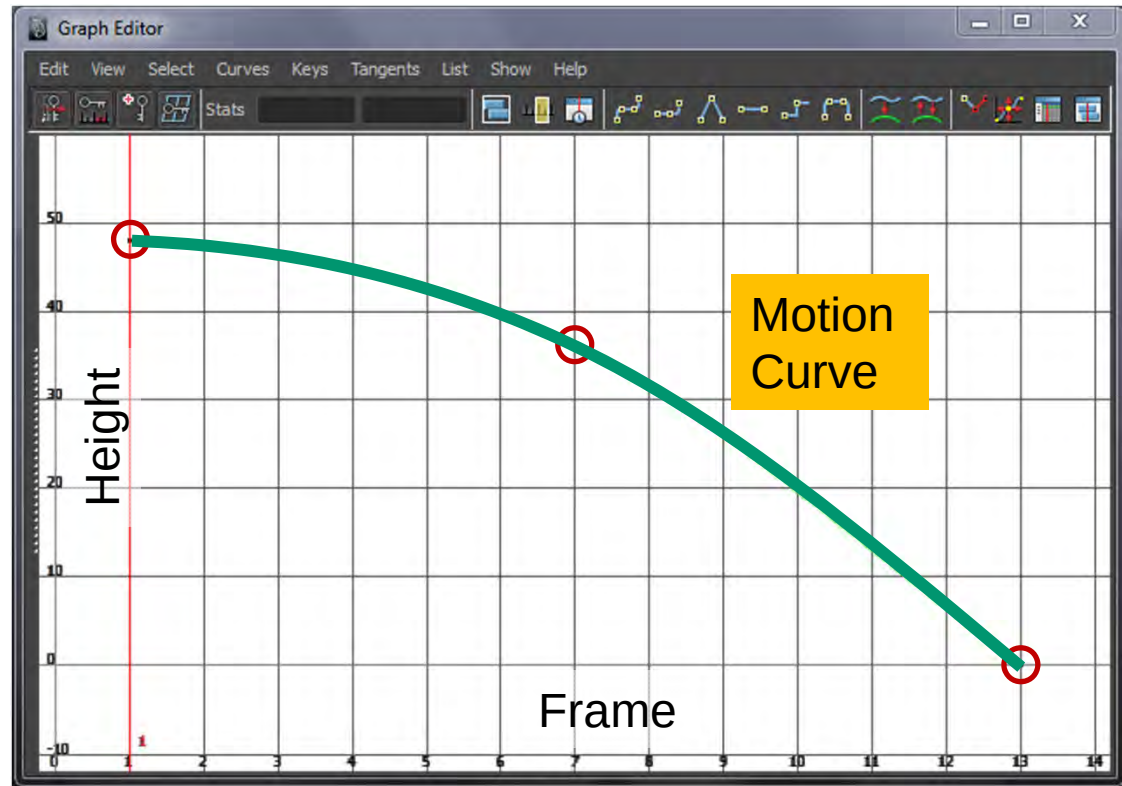
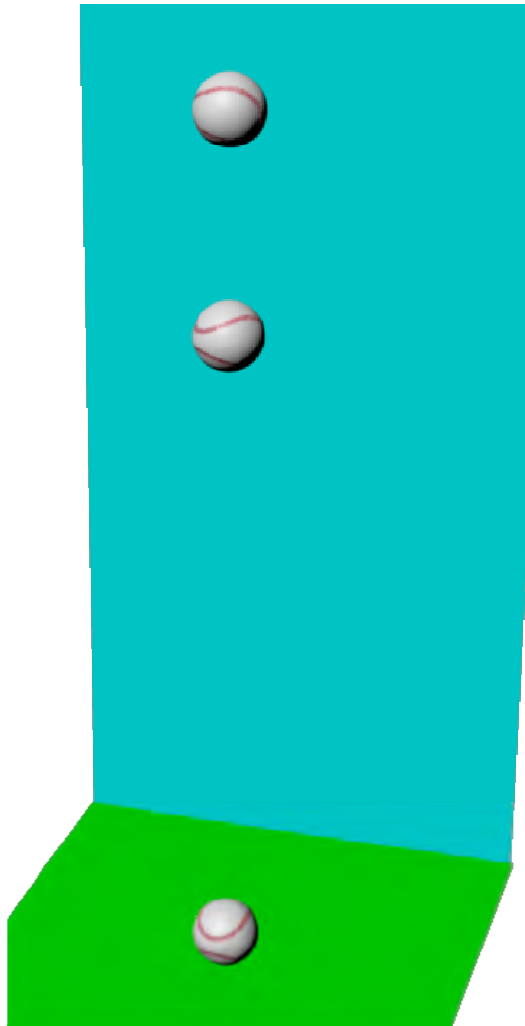
Parabolic Path of Action



Parabolic arcs are a common path of action for falling motion.



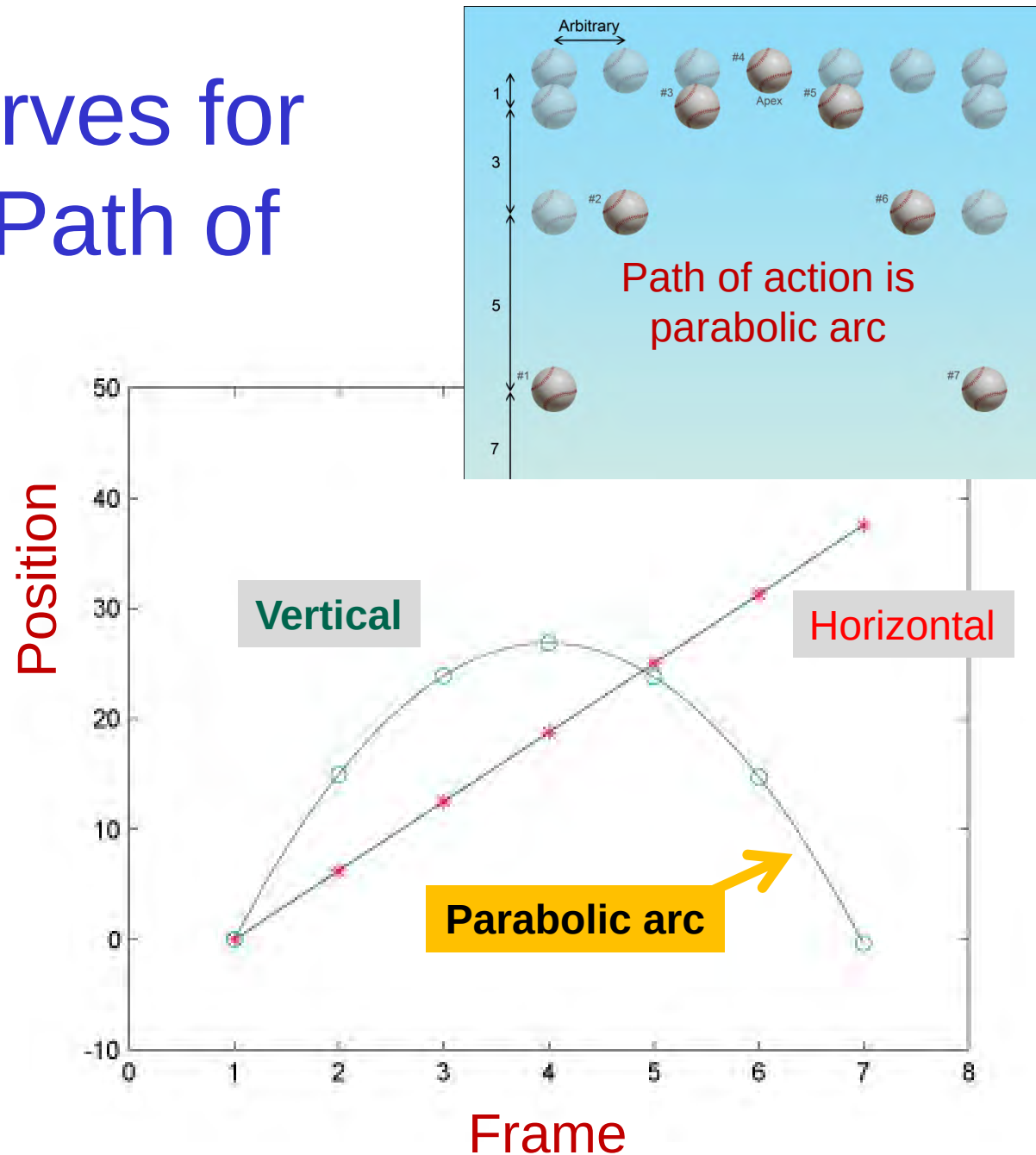
Parabolic Motion Curves



Motion curve for height of a falling object is a parabolic arc in the graph editor.

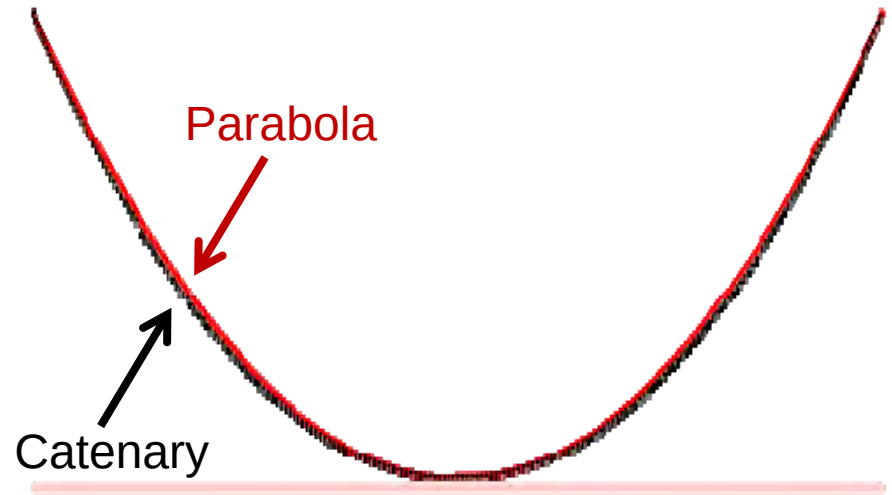
Motion Curves for Parabolic Path of Action

The motion curves for a ball thrown into the air.

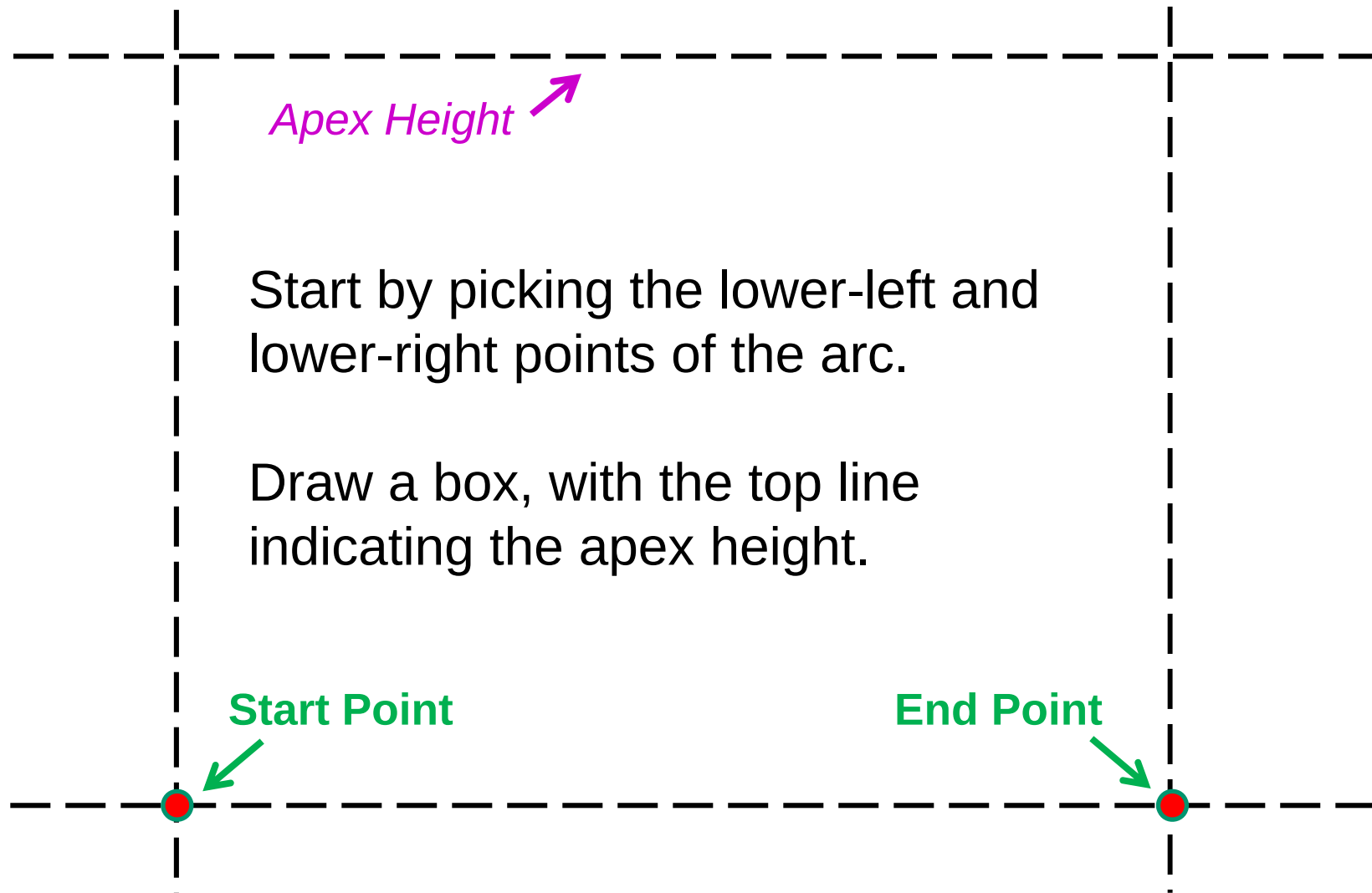


Catenary Arc

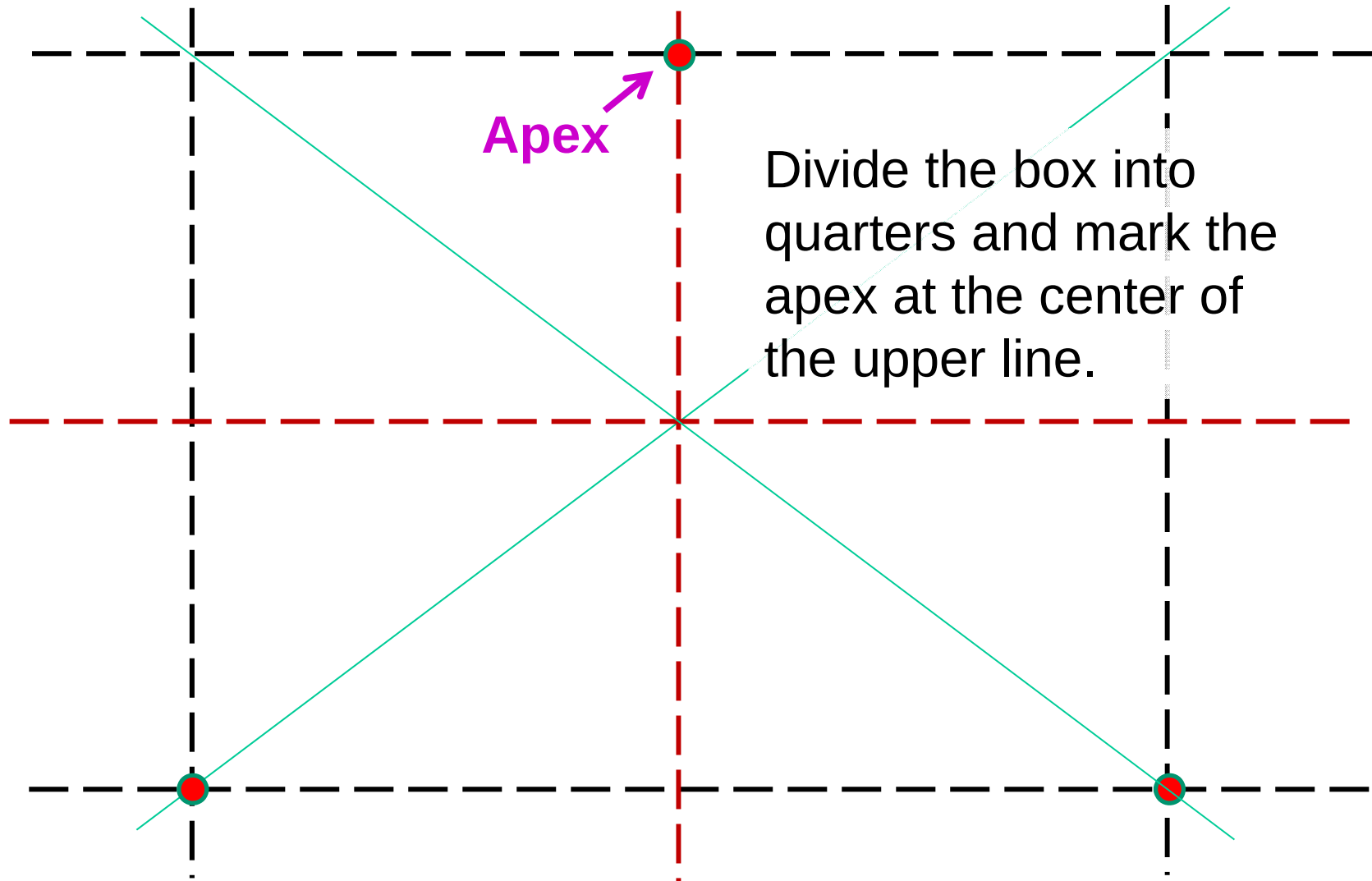
Catenary arcs are the shape of hanging lines; very similar to parabolic arcs.



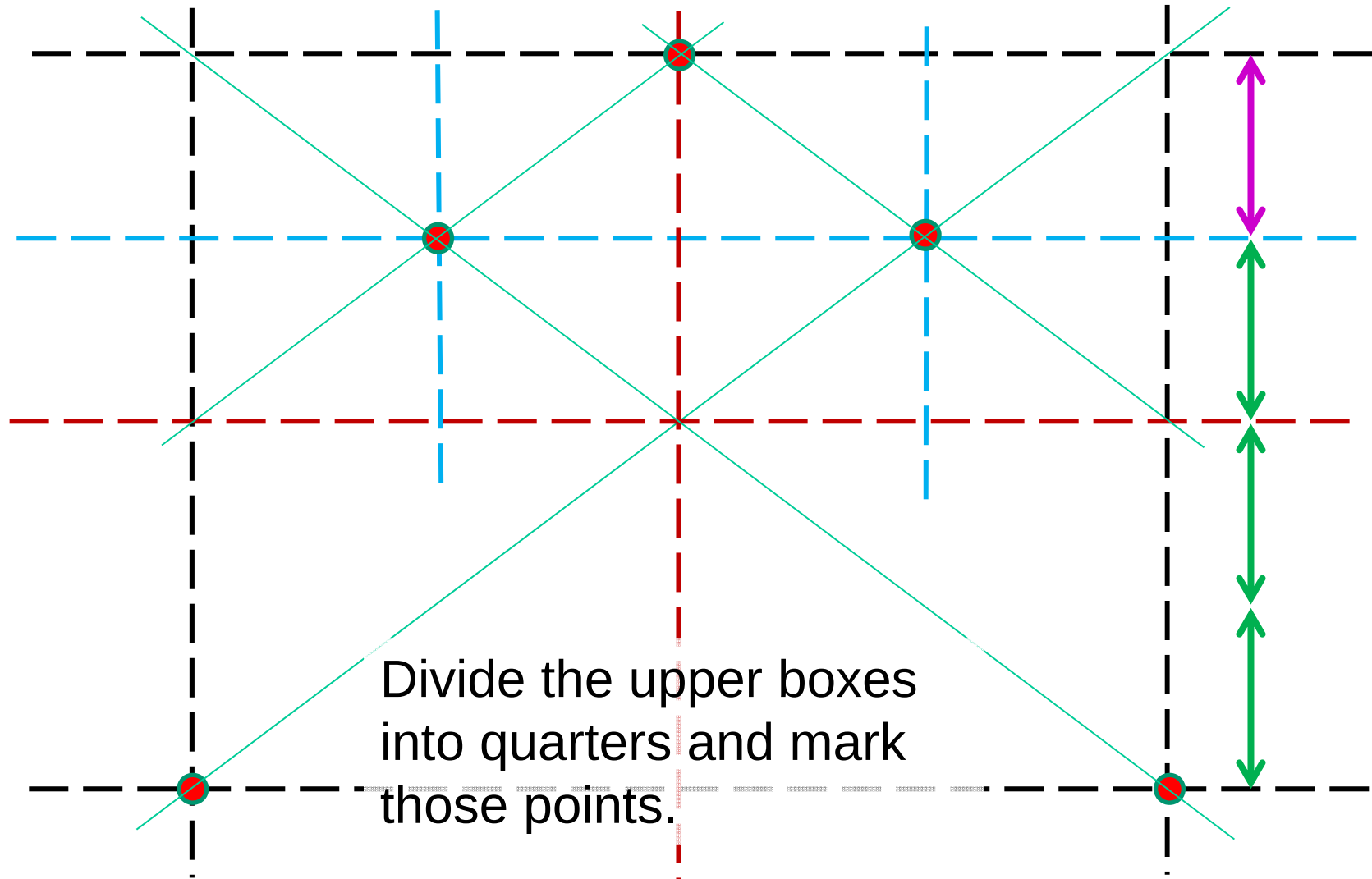
Sketching a Parabolic Arc (1)



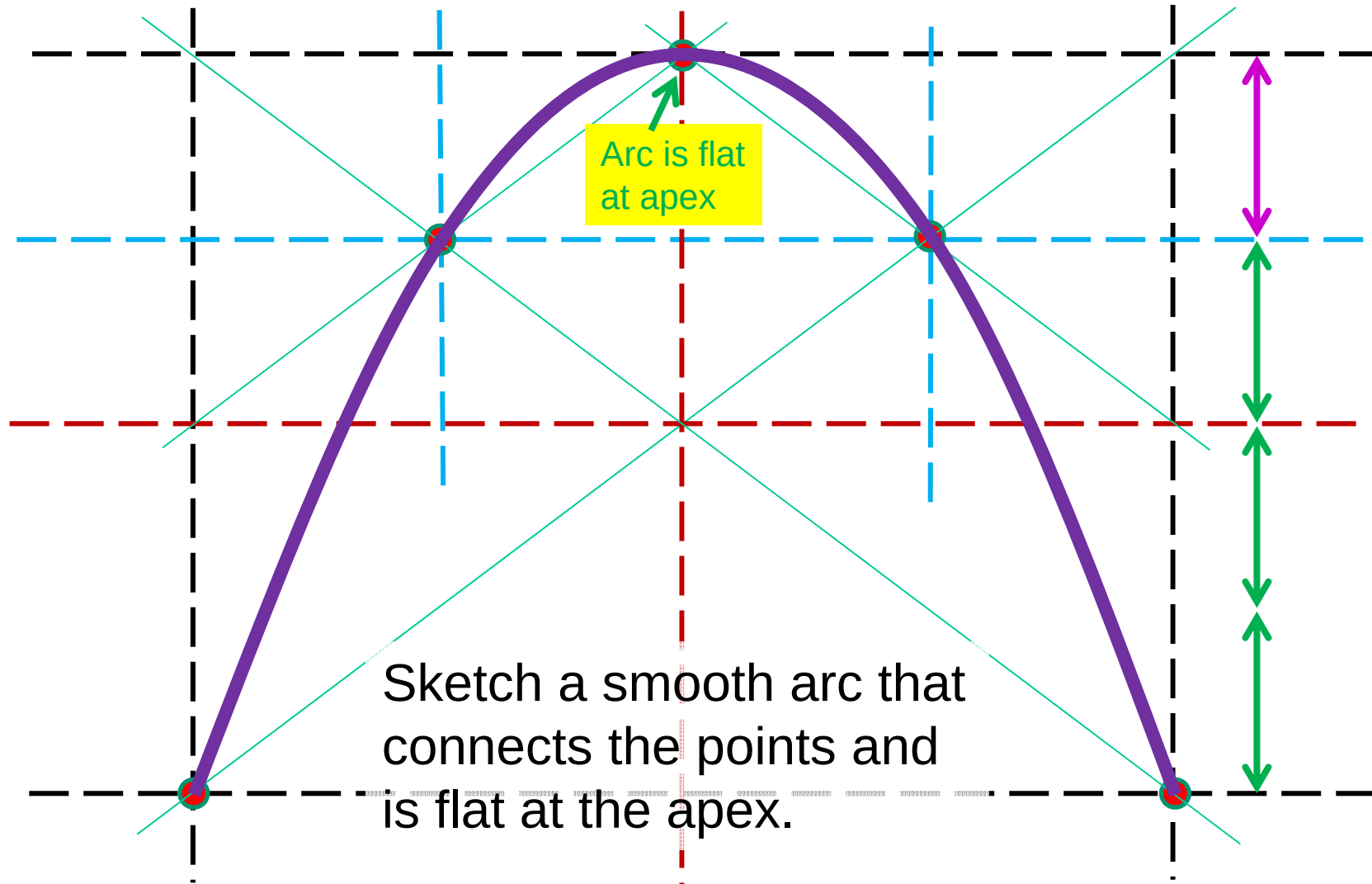
Sketching a Parabolic Arc (2)



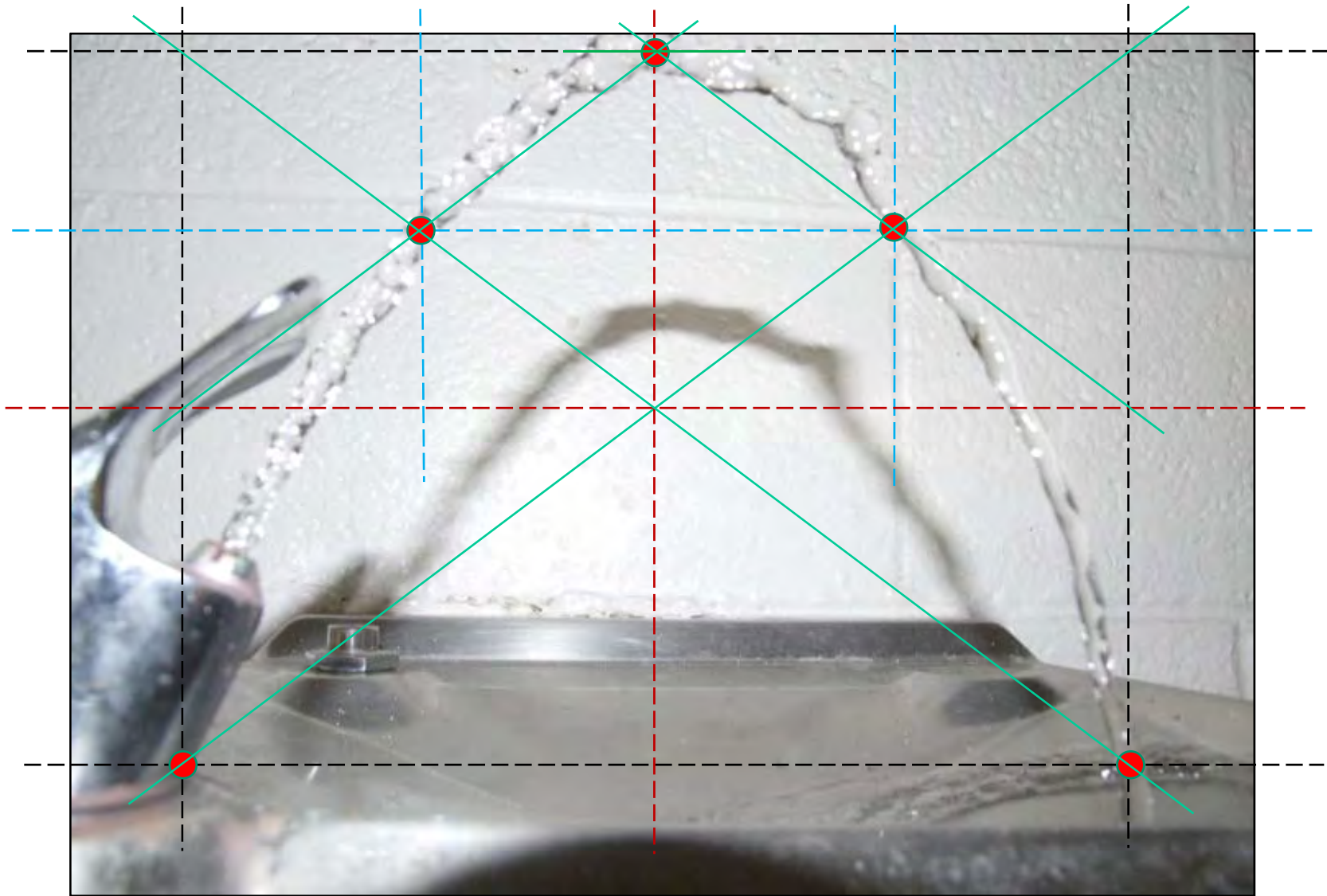
Sketching a Parabolic Arc (3)



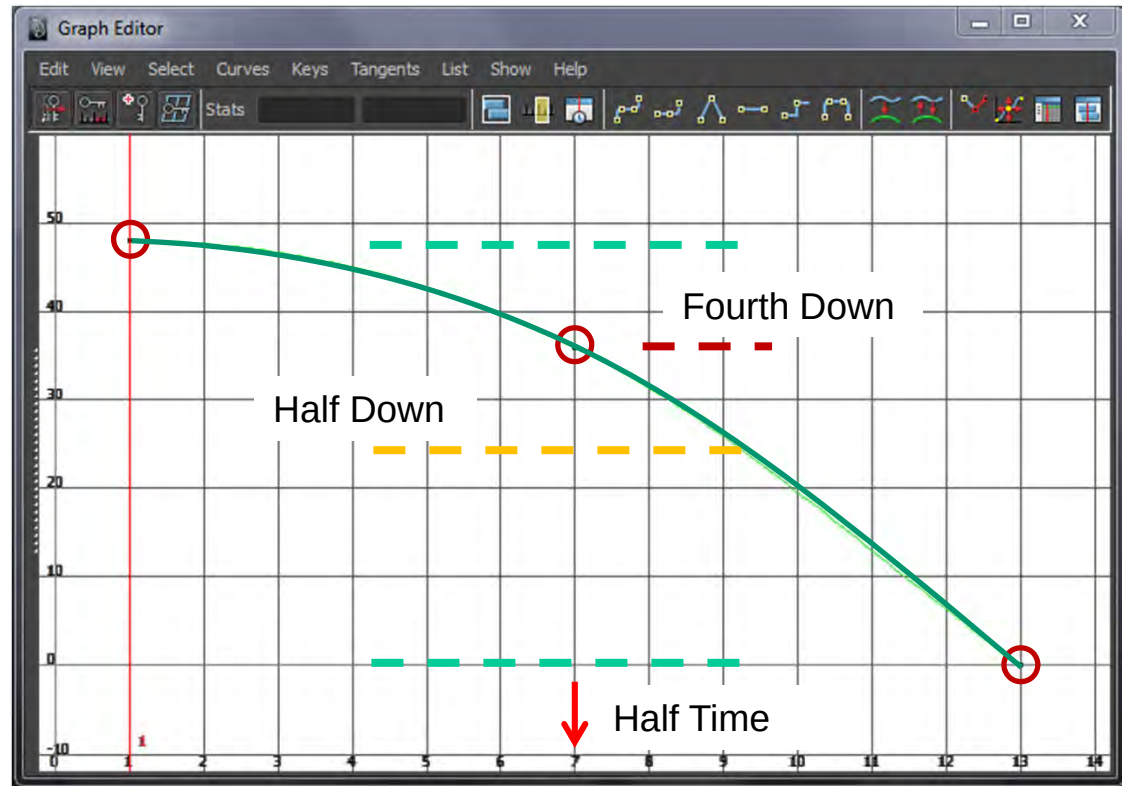
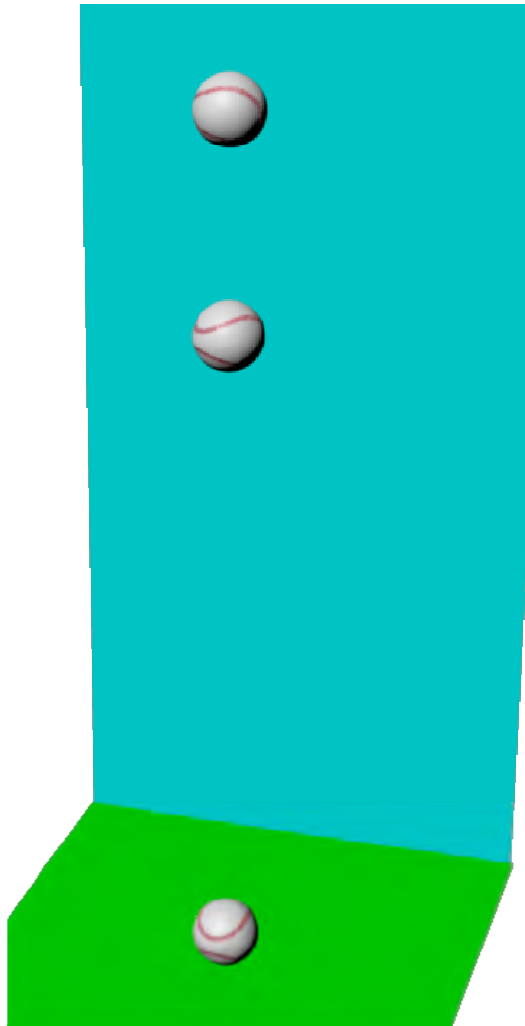
Sketching a Parabolic Arc (4)



Sketching a Parabolic Arc (5)



Sketching Arcs in the Graph Editor



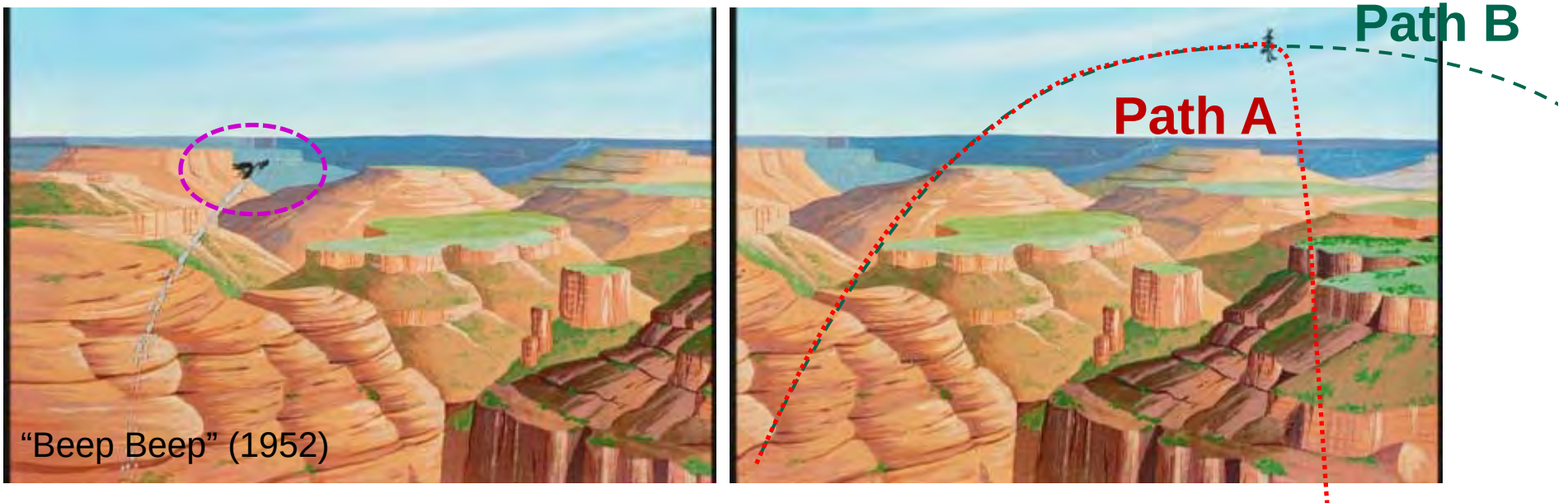
The graph editor has a grid so the Fourth-down at Half Time point for a parabolic arc is easy to estimate.

Beep Beep (1952)



Beep Beep (1952)

Wile E. Coyote travels in a parabolic arc up to the apex, then stops and falls straight downward.



Path A is the cartoony path of action and
Path B is the physically correct path of action.

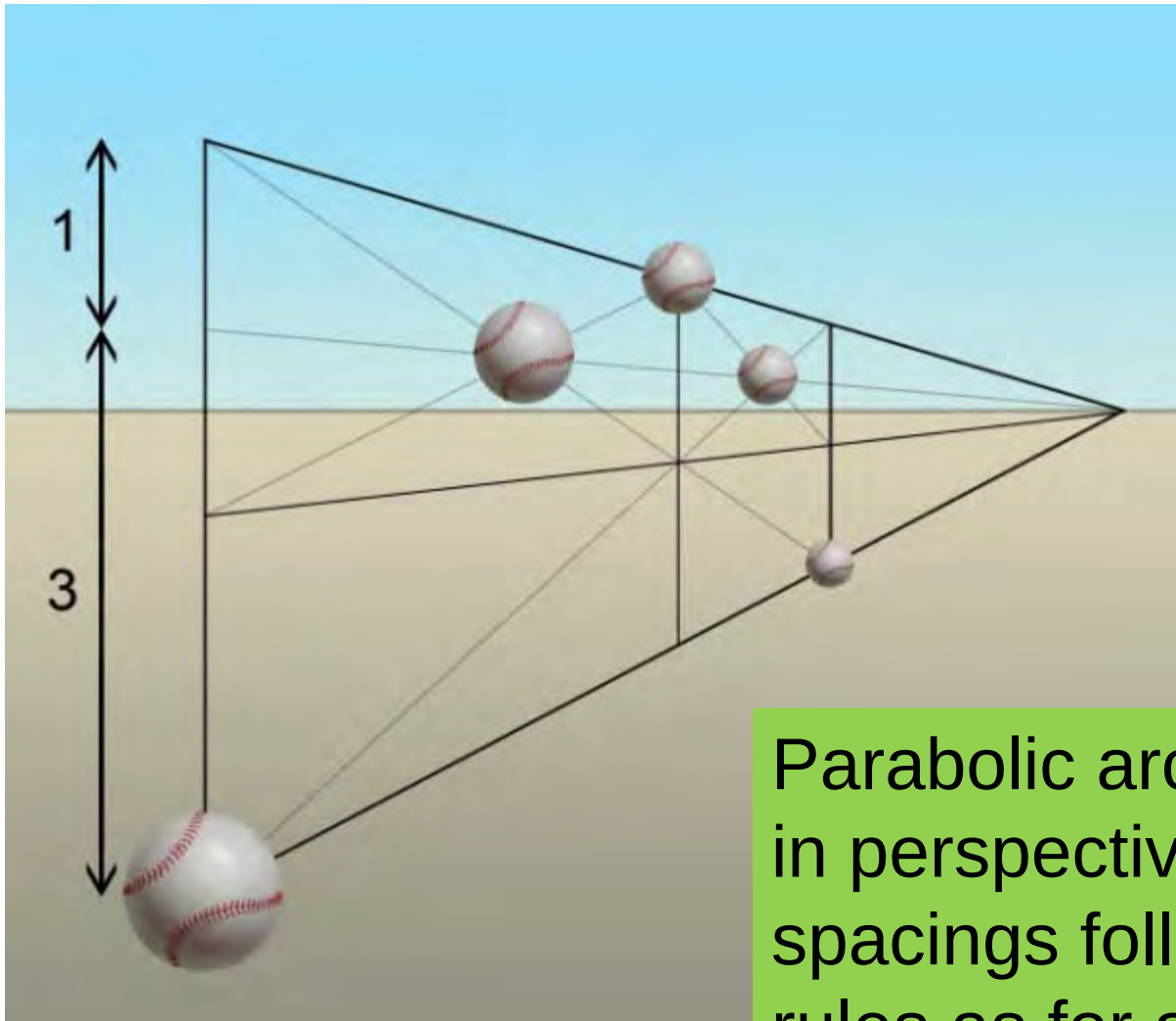
Bending the Laws of Physics

Wile E. Coyote takes a beating but we don't feel that it's animal cruelty because the laws of physics are bent, reminding us that he's in a cartoon universe.



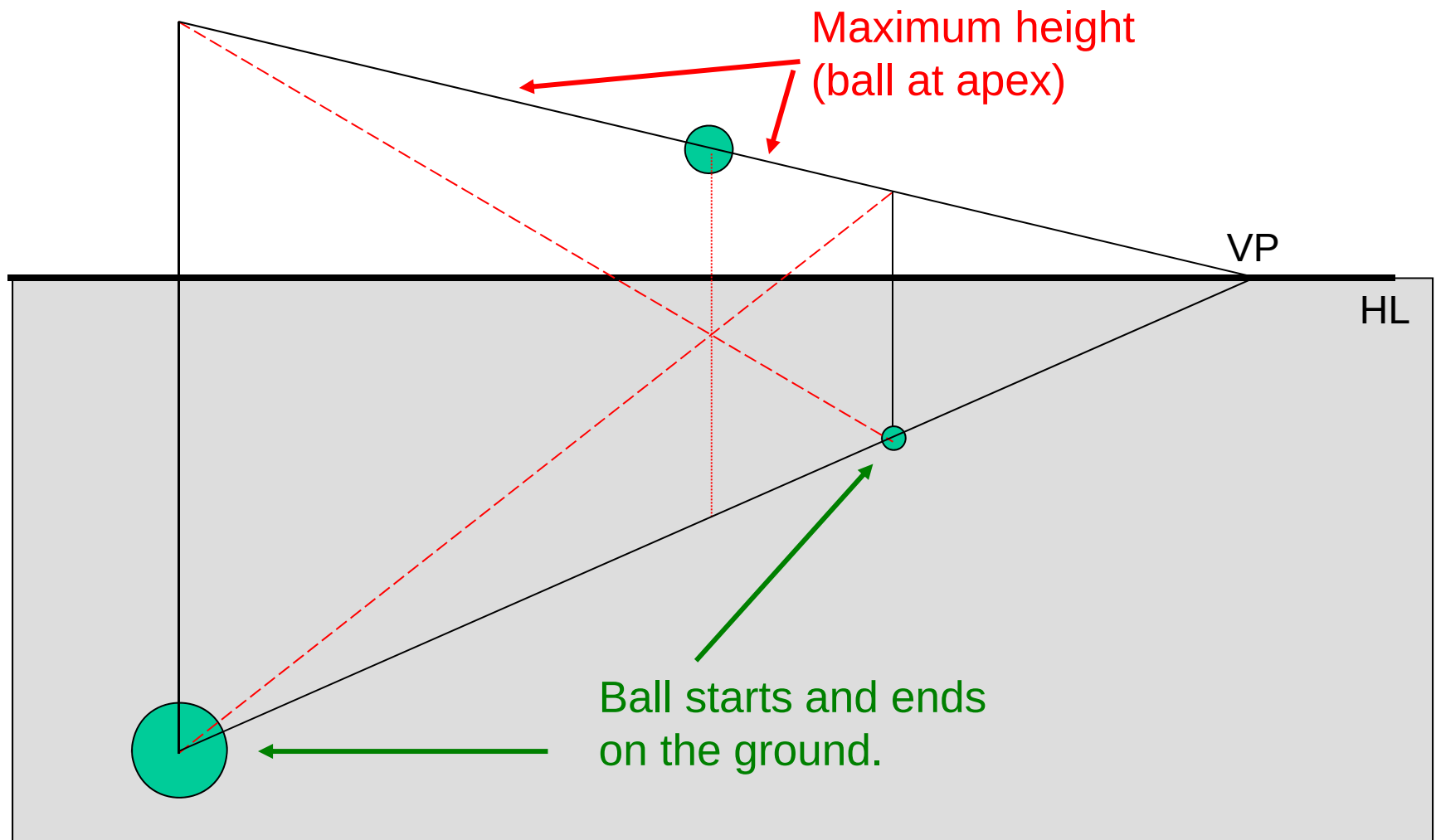
Making the action more realistic would change our emotional reaction to the scene.

Arcs in Perspective

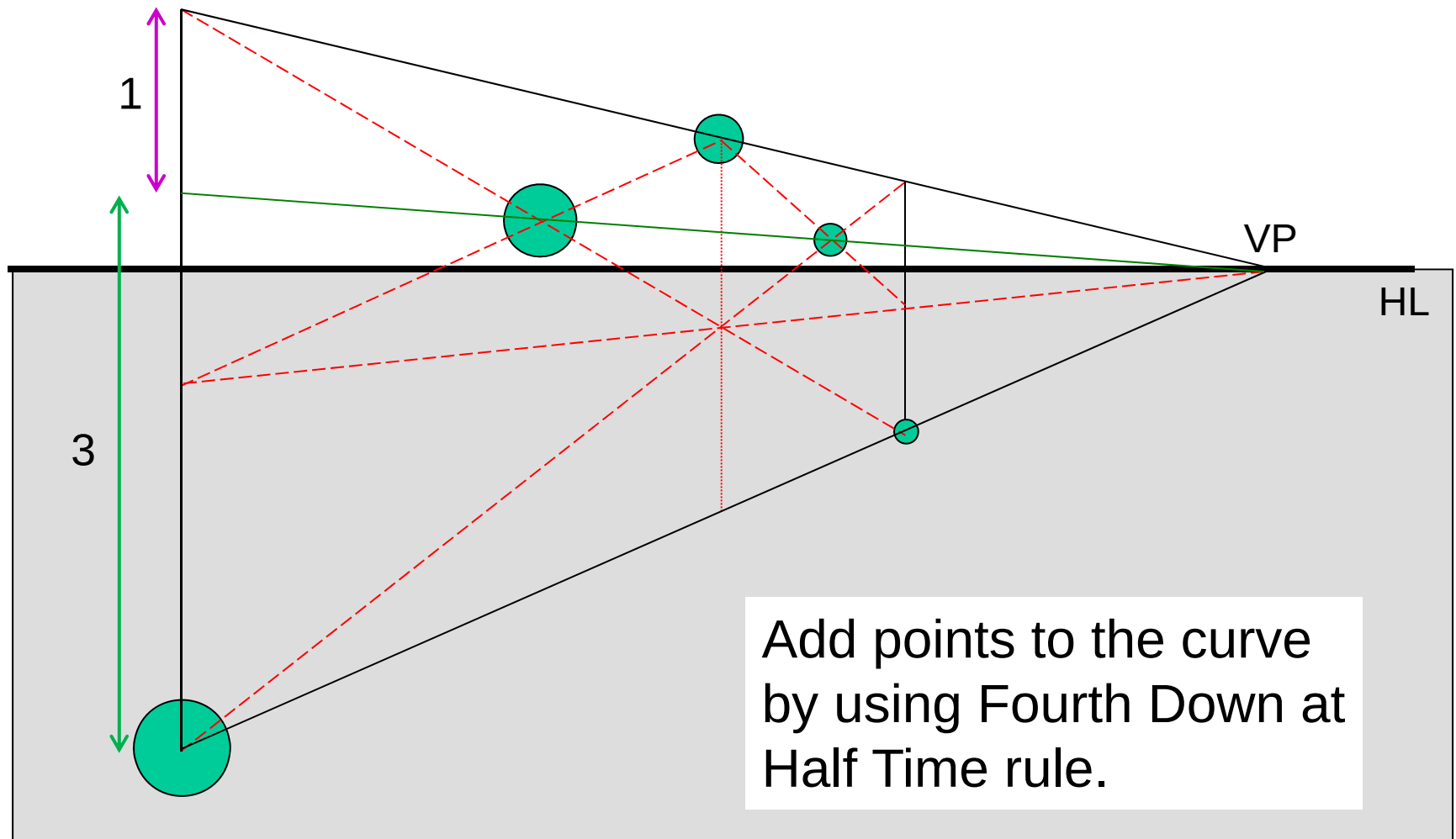


Parabolic arcs look different in perspective but the spacings follow all the same rules as for arcs in profile.

Parabolic Arcs in Perspective



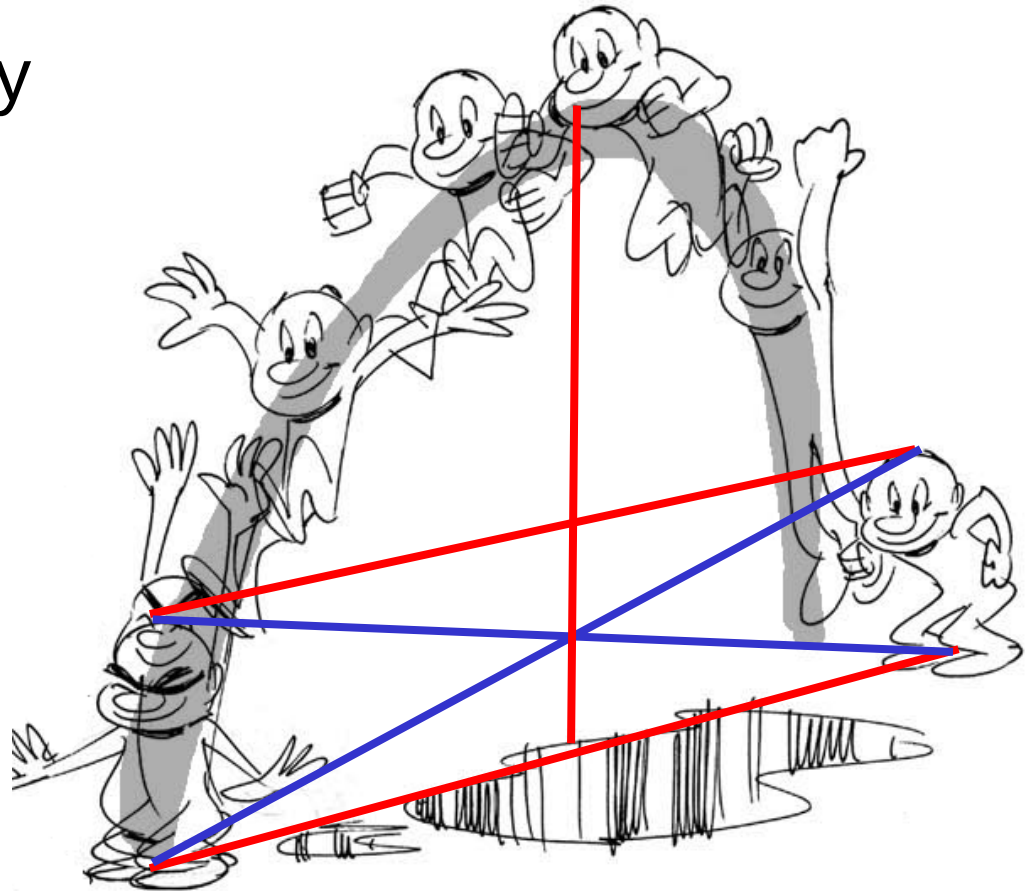
Parabolic Arcs in Perspective



Sketch a smooth arc connecting the points.

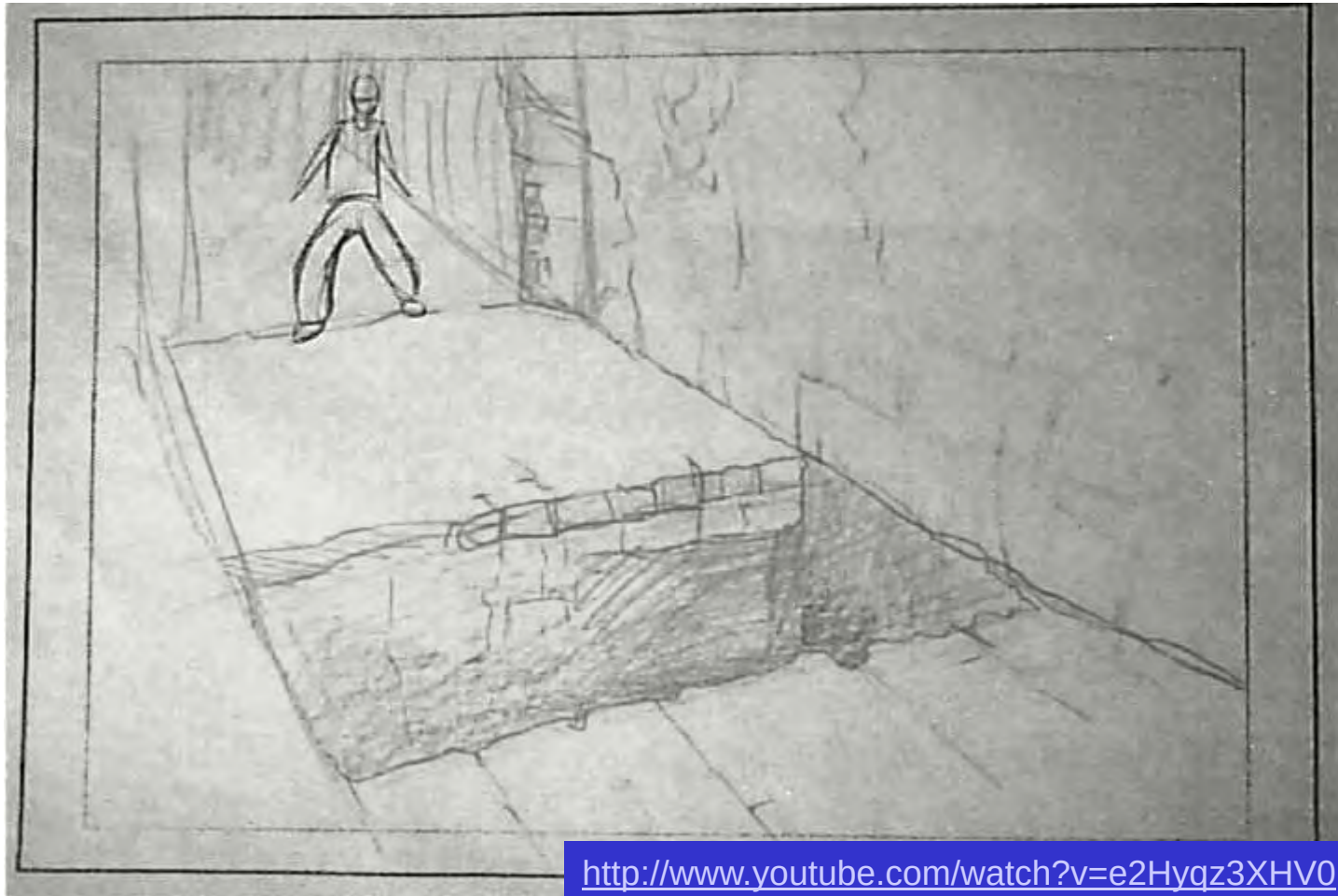
Apex of an Arc in Perspective

Apex needs to be above the half-way point between take-off and landing, which is harder to judge with perspective.



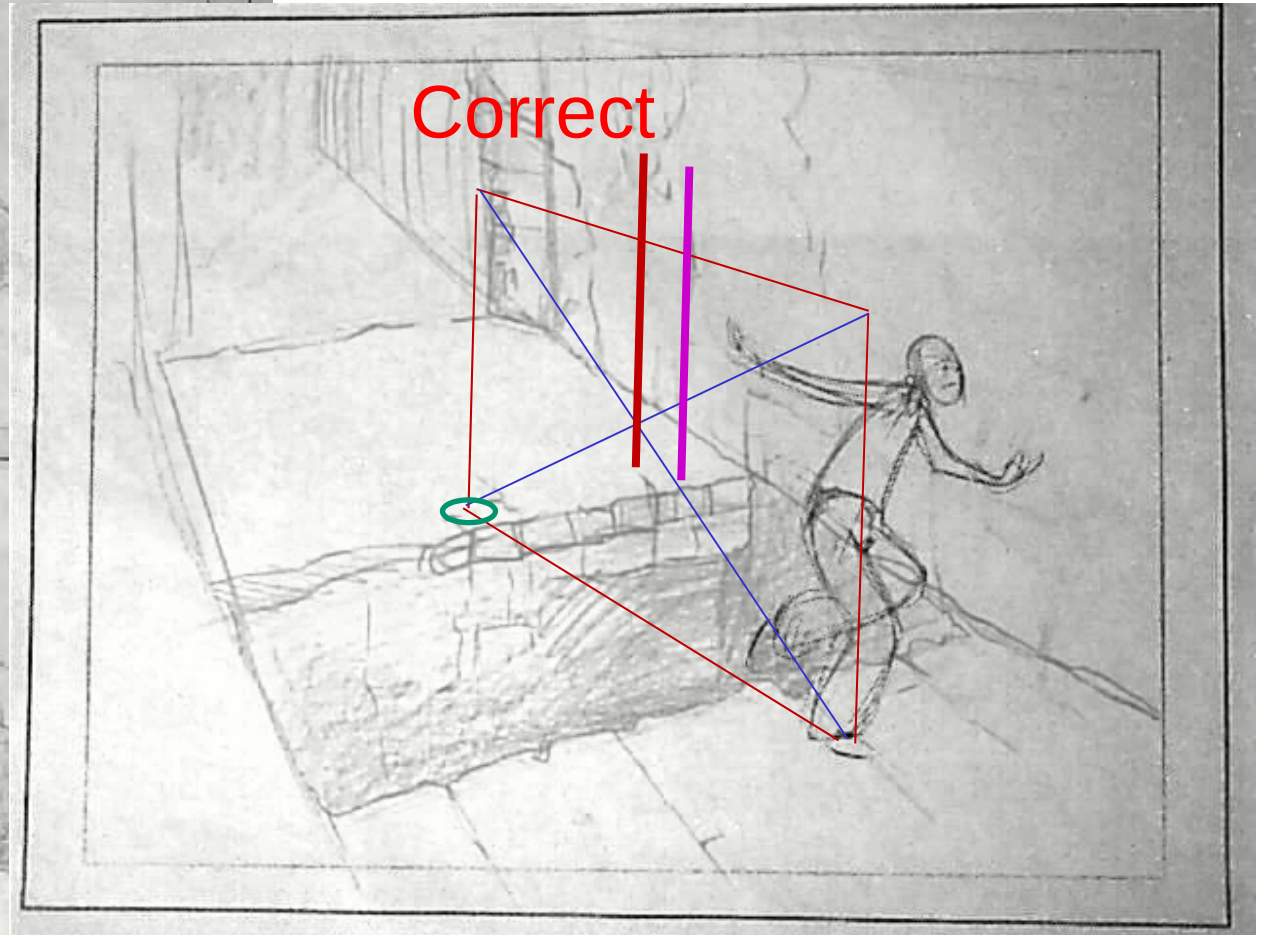
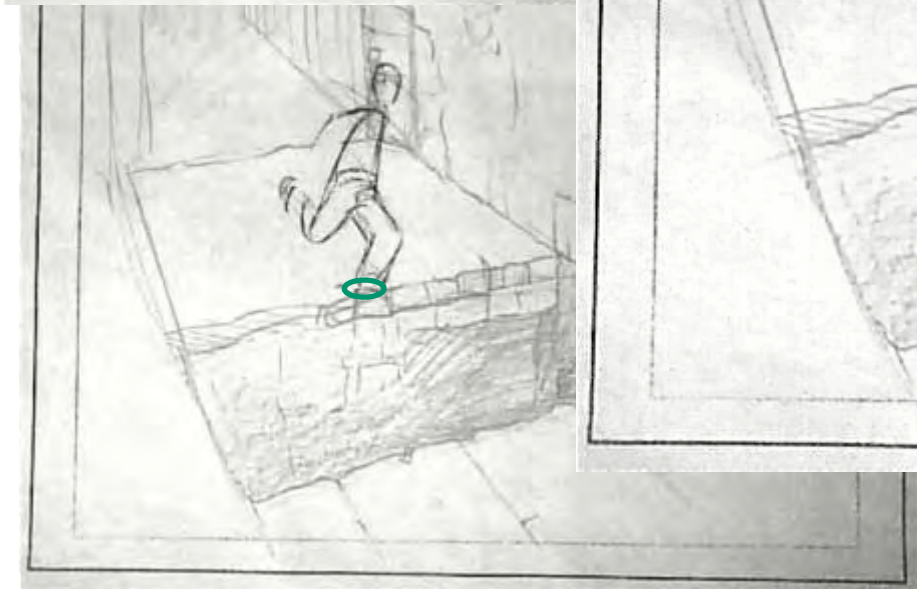
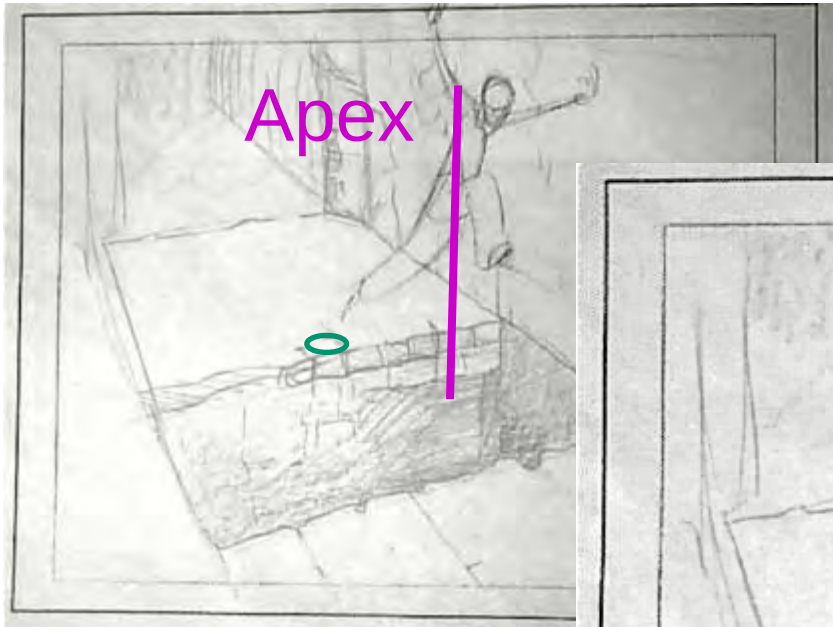
Apex of a Jump

Rishon Wagner



Let's check if the apex of this jump is correct.

Apex of a Jump

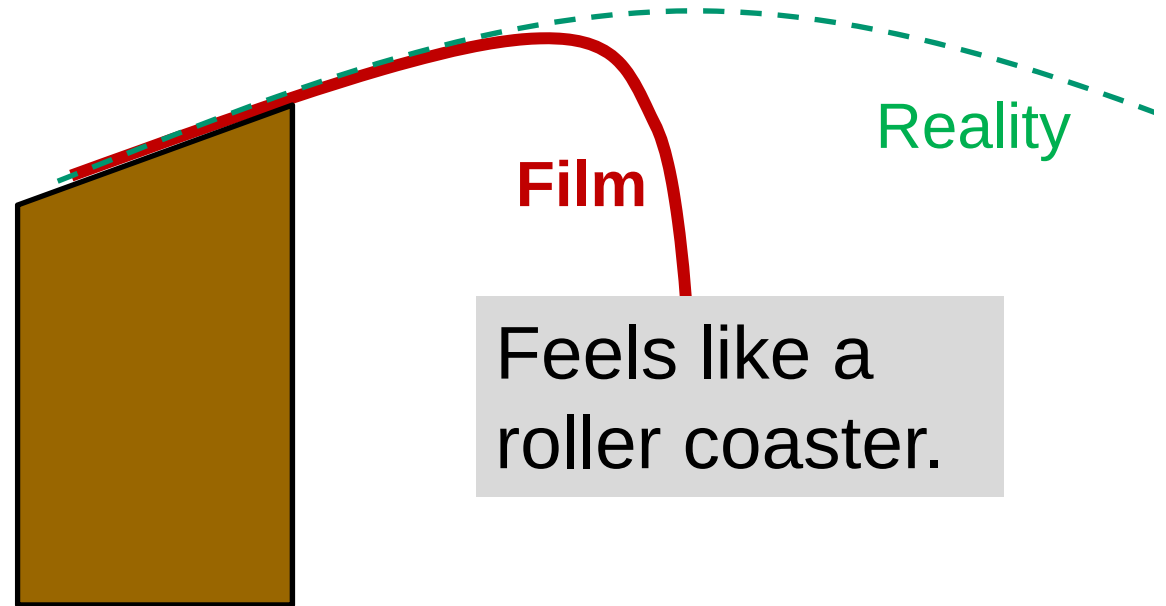


Madagascar 2 (2008)



Madagascar 2 (2008)

The arc is shallow when the plane flies off the cliff but it is very steep after the apex.



Summary

- To sketch a parabolic arc you pick the endpoints and the height of the apex; the position of the apex is between the endpoints.
- To find the points on each side of the apex you use the Fourth Down at Half Time rule.
- Sketching arcs in perspective requires drawing vertical lines as verticals and horizontal lines converging to a vanishing point.
- Sketching an arc is useful for checking the position of the apex in a jump.
- The shape of the arc may be distorted to change the emotional impact in a scene.