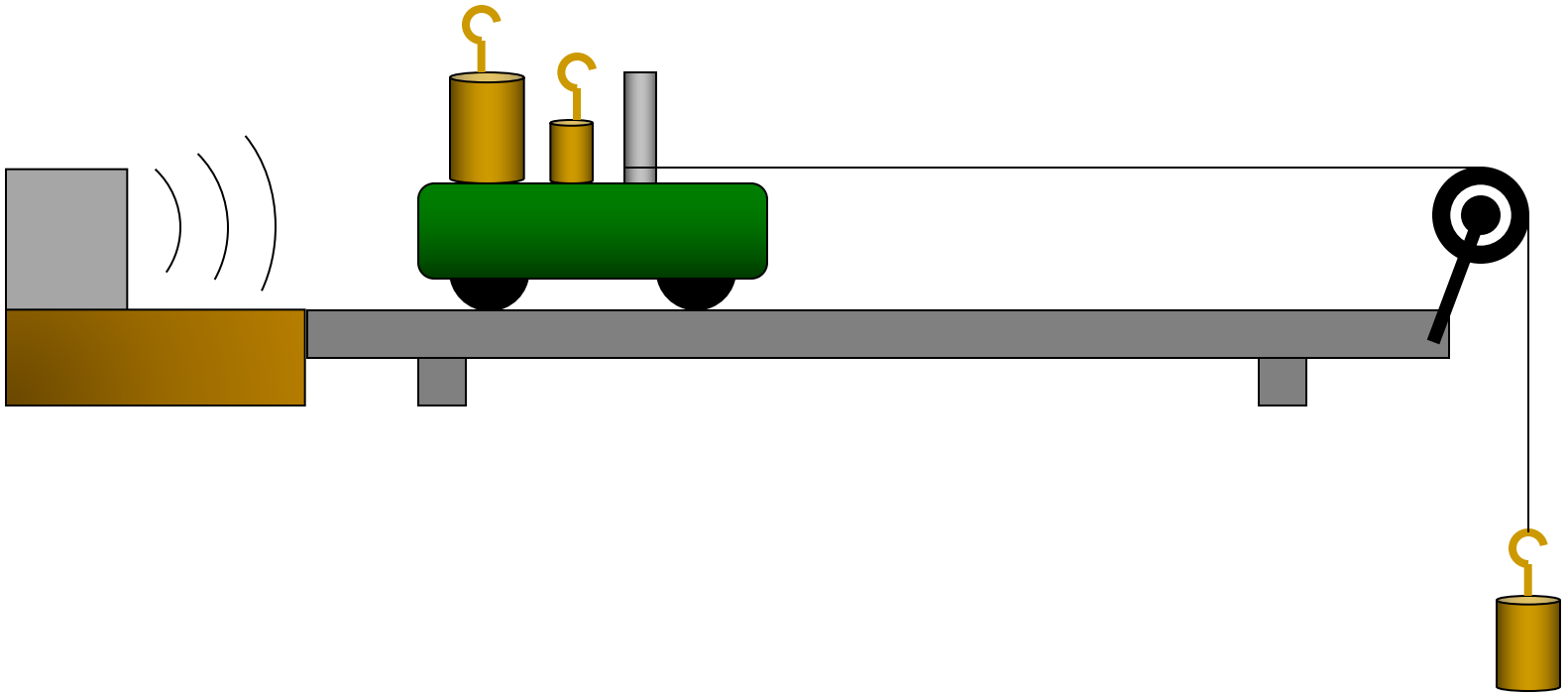
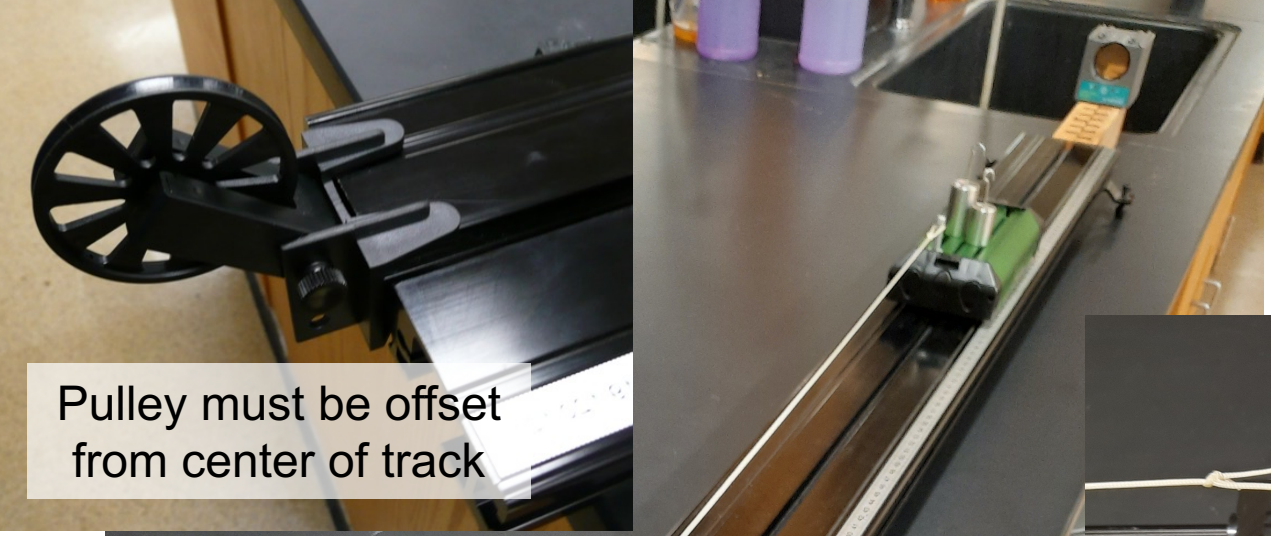
Newton's 2nd Law – Lab Preparation

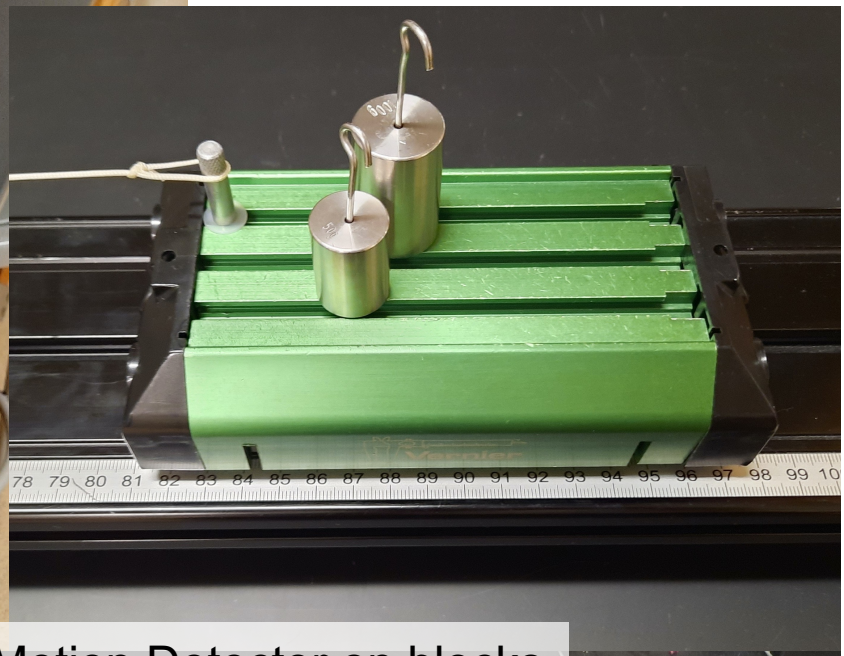


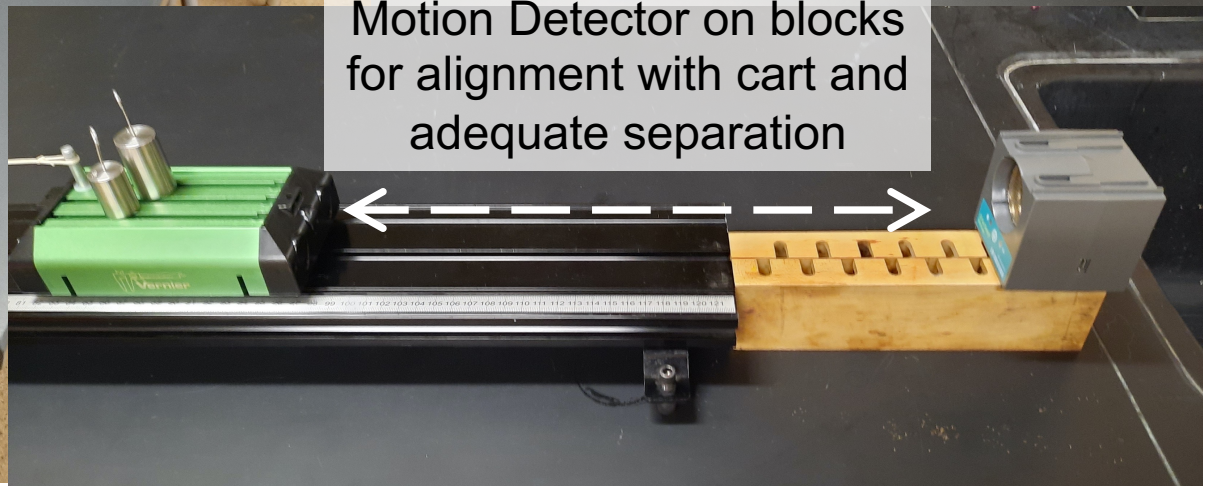
Tips for Success

- The sequence of steps is important – read and follow the procedure in order.
- Complete top two sections on both sides of the data sheet – the bottom sections on each side can be completed later if necessary.
- **Catch** the cart before it reaches the end of the track *and* before the hanging mass(es) hit the floor! No parts should "go flying" – please!!
- Do ***NOT*** hang a large mass on the end of the string to "see how fast it will go". Follow directions!
- Take care of equipment and return everything the way you found it.



Pulley must be offset from center of track



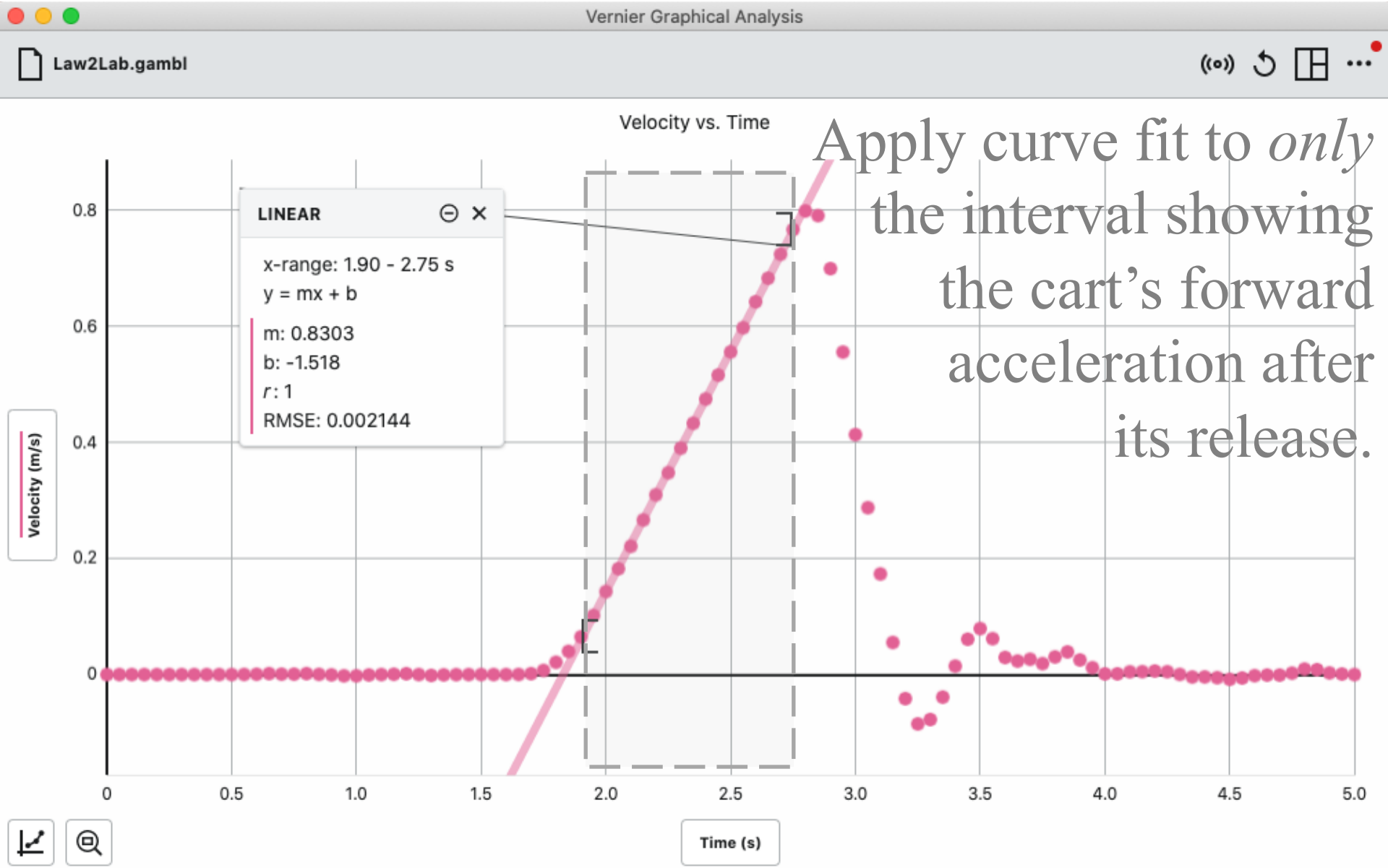


Motion Detector on blocks for alignment with cart and adequate separation

Acceleration

- Acceleration is found by using a linear fit on a selected portion of the velocity vs. time graph.
- Motion detector must be at least 0.3 m (12 inches) away from the target object to function properly. Make sure there is nothing besides the cart from which the sound waves can reflect.
- Be patient with the motion detector – adjust the direction it points and repeat if necessary to get a nice graph of velocity.


Vernier Graphical Analysis
Law2Lab.gambl
Velocity vs. Time
The gold data is not very good. It appears cart was too close to the detector.
The red data is very good. It clearly shows the cart accelerating from rest and then being caught.
Velocity (m/s)
0.8
0.6
0.4
0.2
0
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Time (s)



Apply curve fit to *only* the interval showing the cart's forward acceleration after its release.

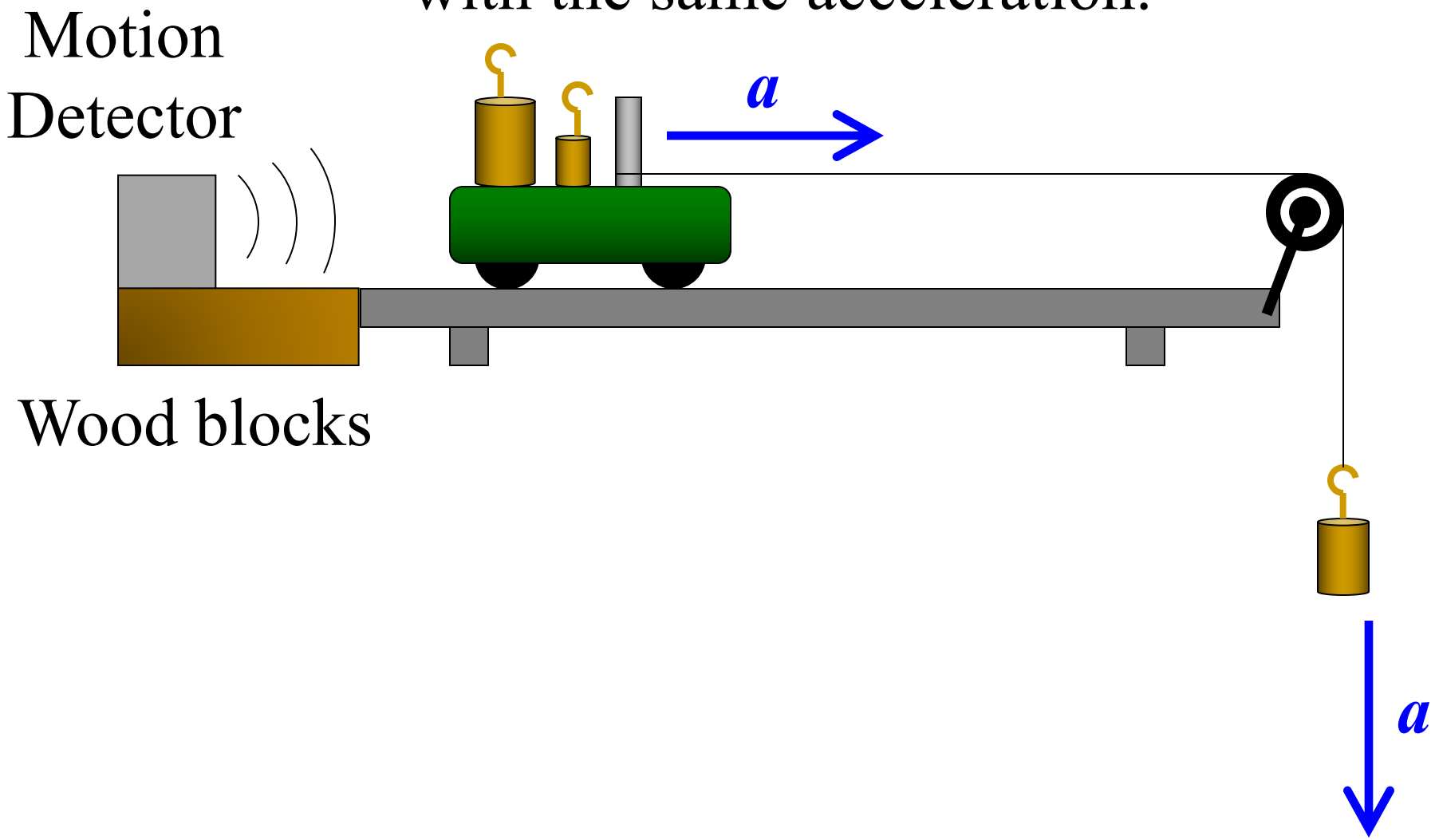
Mass

- Use the triple beam balance to complete the mass tables.
- The calibrated masses can be equal to the value stamped in the metal. Or, if you prefer, you may measure with the balance. (Should be very close to indicated value.)

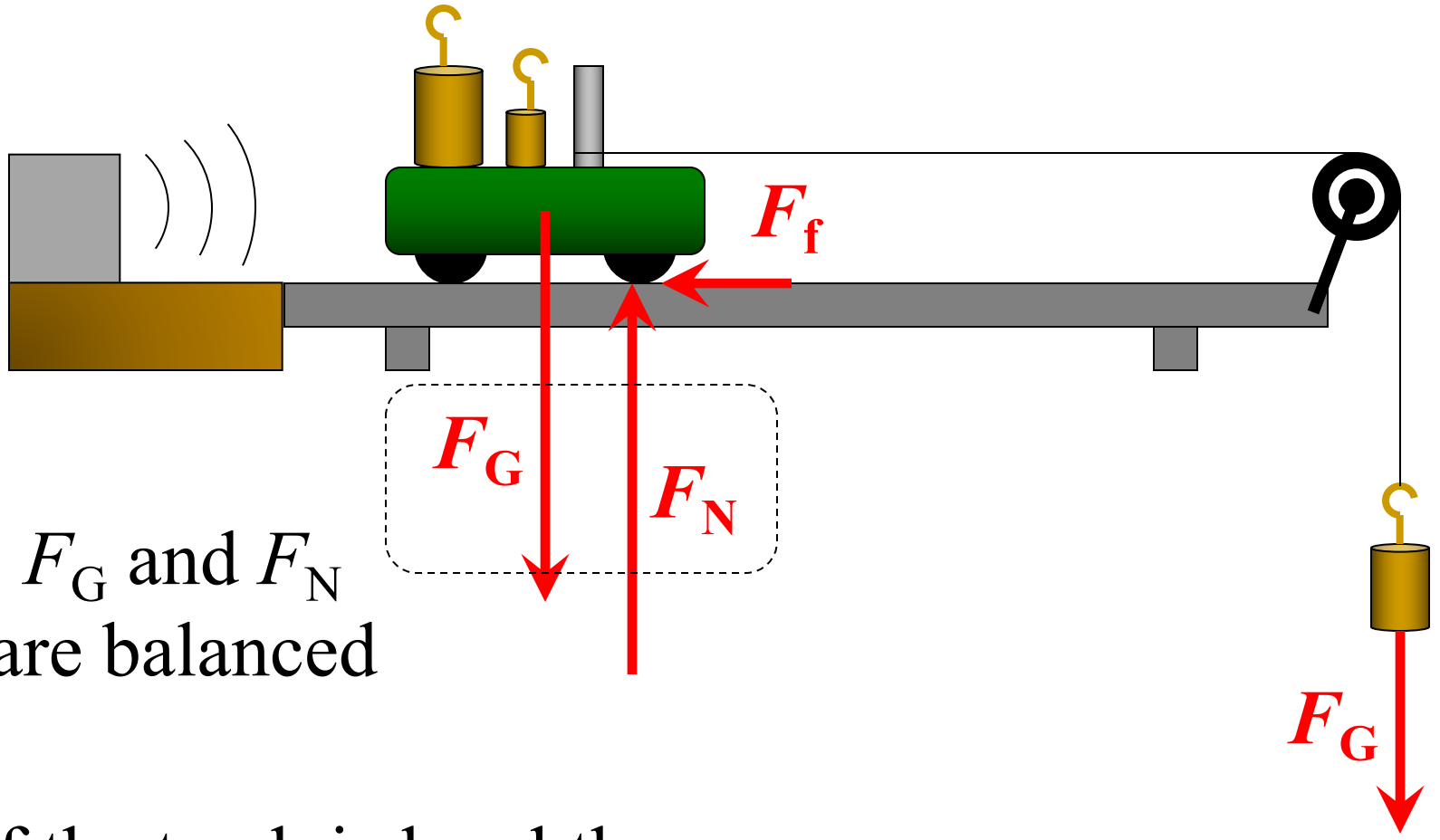
Force

- The force that is causing everything to accelerate is gravity acting on the hanging mass.
- All other forces are balanced and do not contribute to the net force if the entire assemblage is considered to be one object. The tension in the string is internal to the system.

The cart and hanging weight move with the same acceleration.



Consider *all* of the moving pieces as <u>*one*</u> "object".
What are the external forces on the *system*?

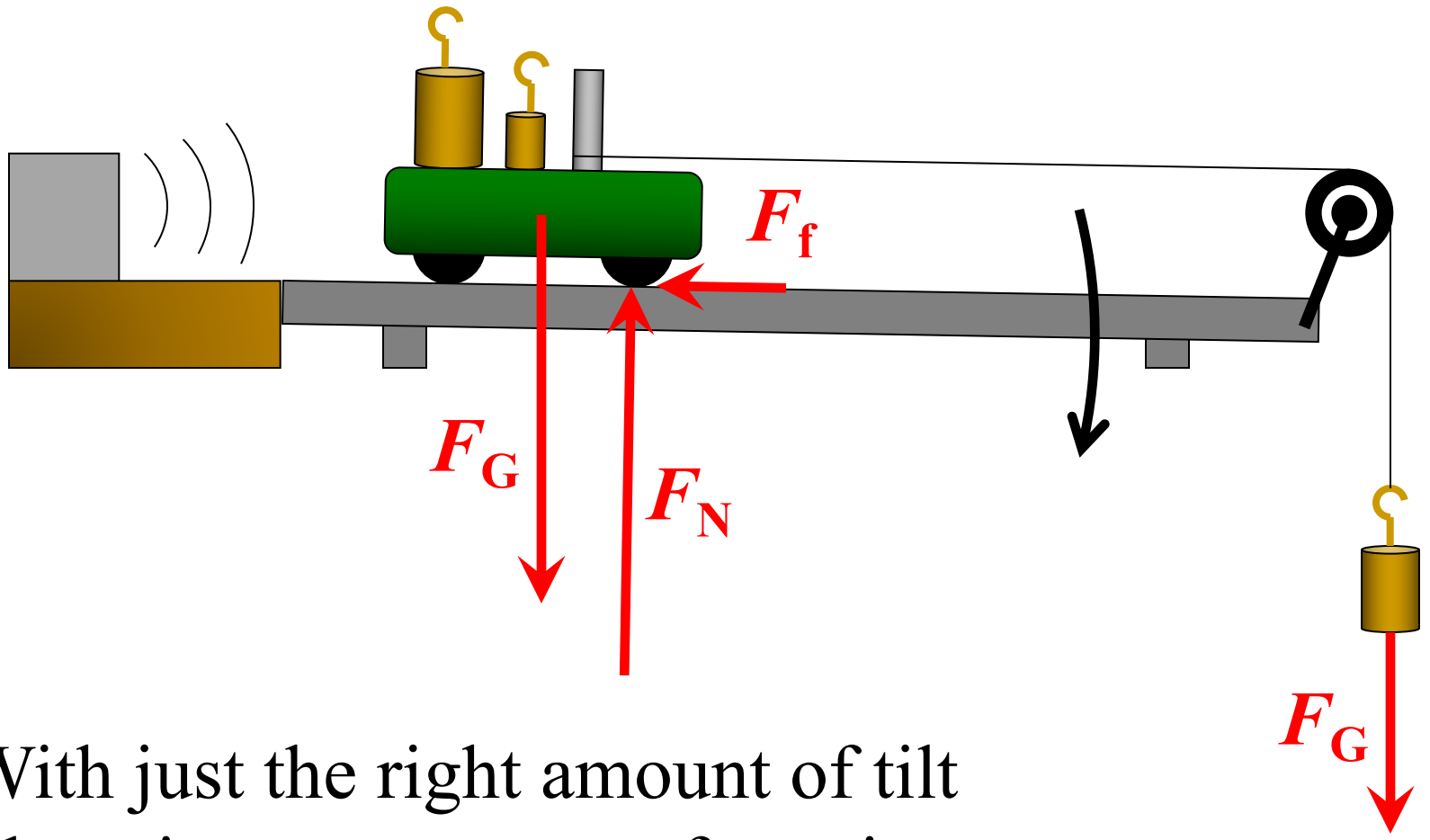


F_G and F_N are balanced

If the track is level then friction affects the system.

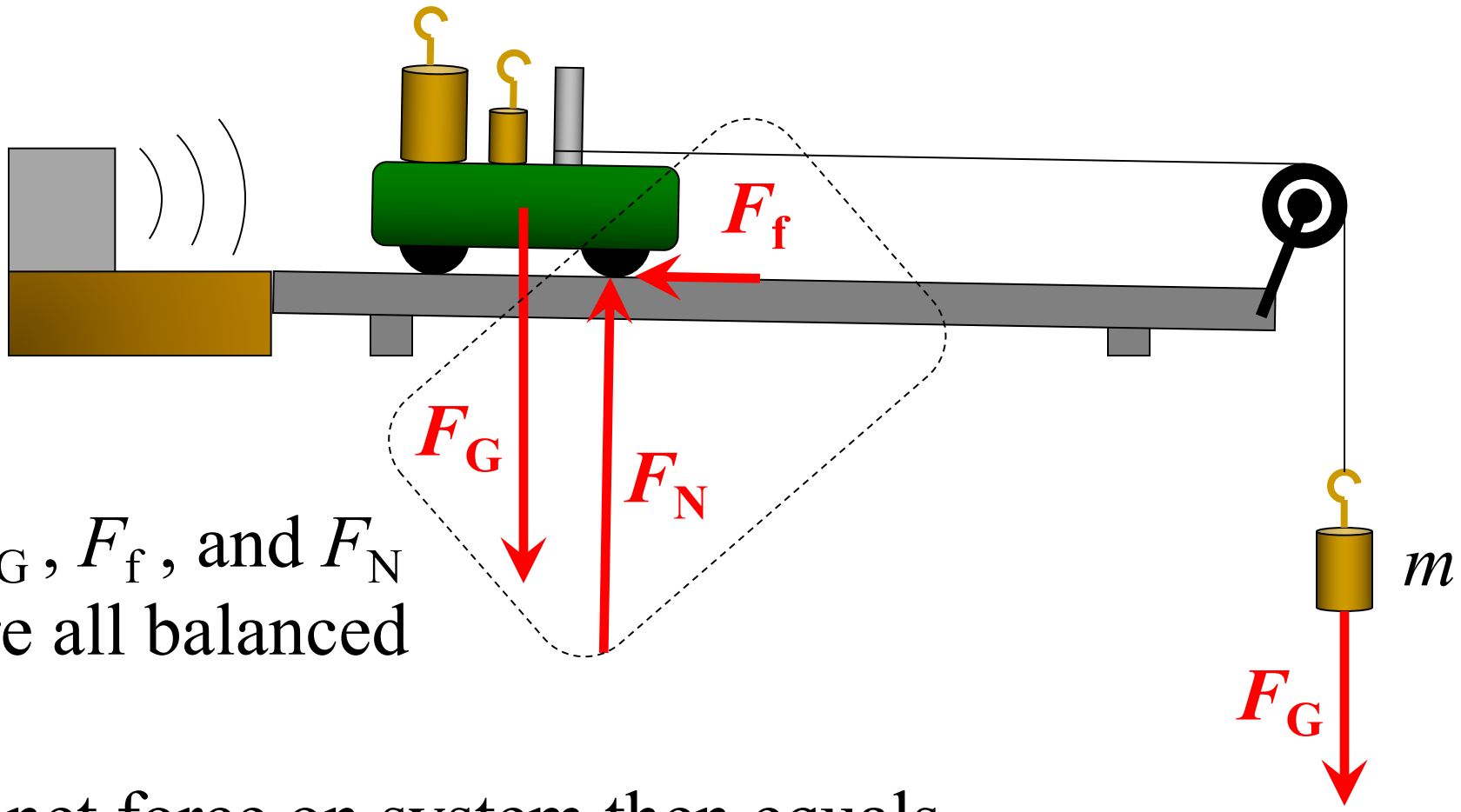
$$F_{net} = F_G - F_f$$

As explained in the procedure the track is tilted slightly to counteract friction.



With just the right amount of tilt there is a component of gravity that will balance friction.

As explained in the procedure the track is tilted slightly to counteract friction.



F_G, F_f, and F_N are all balanced

The net force on system then equals gravity acting at end of the string.

$$F_{net} = F_G = mg$$