The Effects of Mass and Grade on Cycling Effort

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Bikes are one of the most efficient forms of transportation. One main thing that deters people from this simple form of transportation, is the difficulty of riding up hills and distances. This study was designed to test how the mass of a cyclist affects the amount of energy required to climb up an incline. The hypothesis was that as the mass of the system increases, the energy required would be directly proportionate. The controls were established by testing the amount of work, using a power meter, required to ride a certain distance on flat ground for different masses. Next the amount of work required to climb up a hill was tested for different mass configurations. The data from the flat test was used to cancel out drag and rolling resistance from the amount of work required to climb the hill. A net of 83% of the work required to climb the incline was used to gain elevation. The remaining 17% was used to overcome the rolling resistance and drag. The data support the hypothesis, in that as the mass of the system increased, the energy required to gain elevation increased proportionally. The relationship closely matched the predicted potential energy of elevation, where energy is equal to the mass times the acceleration of gravity, times the change in elevation. Understanding this relationship is critical to facilitate effective bicycle transportation planning.

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