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## Physics Playground: a game to teach qualitative physics

In 2011, we received funding from the Bill & Melinda Gates Foundation to develop an educational video game to help middle school students better understand concepts related to qualitative physics. Qualitative physics is the nonverbal understanding of Newton's three laws of motion: the law of inertia, force is proportional to mass  $\times$  acceleration, and actions have equal & opposite reactions. Since qualitative physics is non-verbal, it is often assessed through pictures. For example, one might ask a student to draw the expected trajectory of a projectile to gauge their understanding of  $F=ma$ .

We worked using evidence-centered design to develop a game to elicit and improve qualitative physics competencies through gameplay. The result of this work is Physics Playground (formerly known as Newton's Playground), a video game that challenges the player to guide a green ball to reach a red balloon by drawing objects in an interactive physics environment. Players draw using the mouse and their drawings become part of the physics environment, interacting with the ball and other objects in the world to complete levels.

