Projectile Motion

Vectors – 2-D Kinematics

I.   Vector Addition/Subtraction
     - Graphical

II. Vector Components
     - Applications

III. Vector Addition/Subtraction
   - Numerical

IV. Relative Motion

V.   Projectile Motion

|	The student will be able to:	HW:
1	Add or subtract vectors graphically and determine a vector's opposite. ✓	1, 2
2	Calculate the components of a vector given its magnitude and direction. ✓	3, 4
3	Calculate the magnitude and direction of a vector given its components. ✓	5 - 9
4	Use vector components as a means of analyzing/ solving 2-D motion problems. ✓	10 - 13
5	Add or subtract vectors analytically (using trigonometric calculations). ✓	14, 15
6	Use vector addition or subtraction as a means of solving relative velocity problems. ✓	16 - 20
7	State the horizontal and vertical relations for projectile motion and use the same to solve projectile problems and apply vector properties to projectile motion.	21 - 38

What is a "projectile"?

- A projectile is an object launched by some initial force, which then proceeds under the sole influence of gravity.

- The equations you will learn apply to the subsequent motion of the object *after* launch and *before* impact.
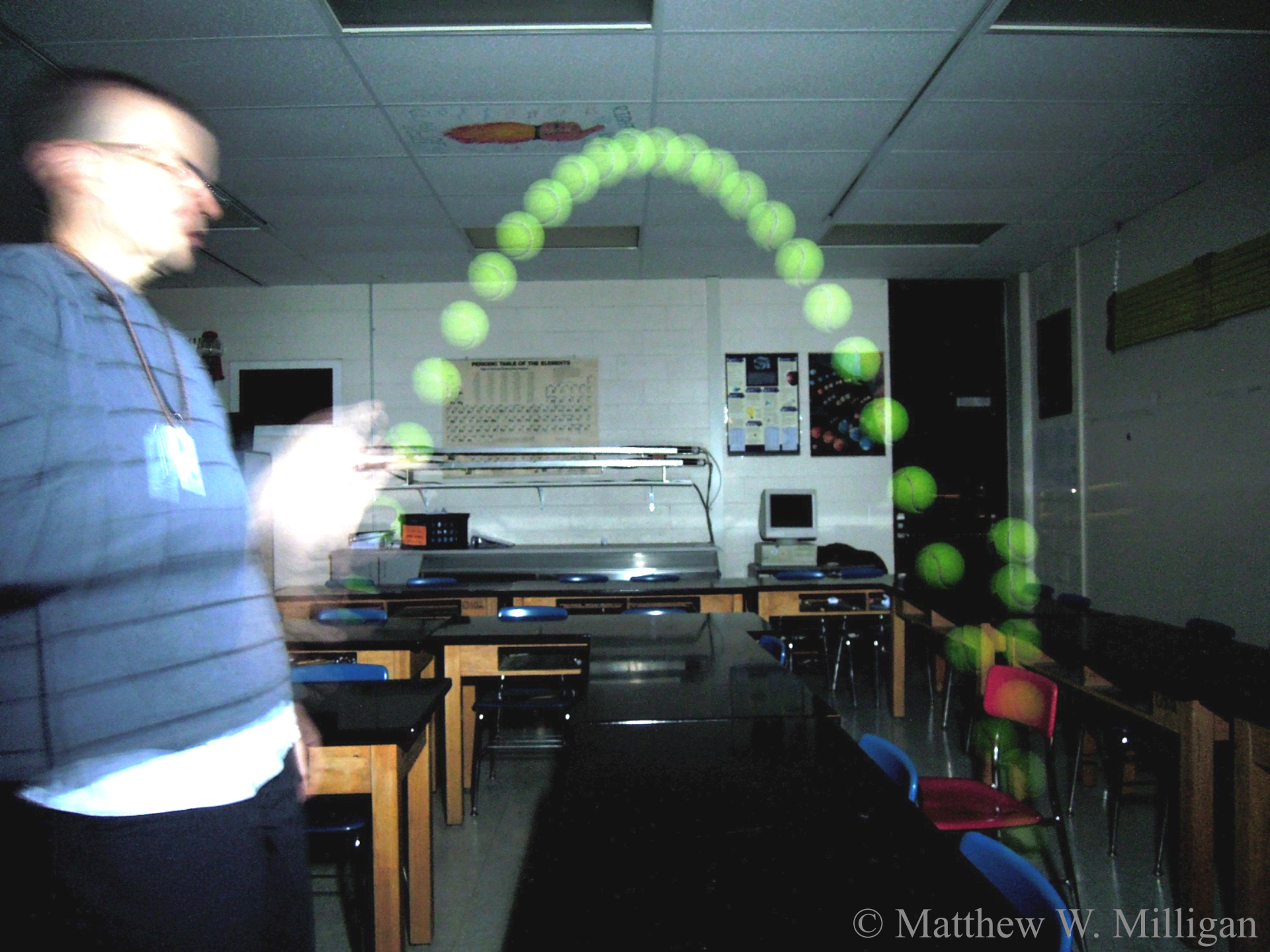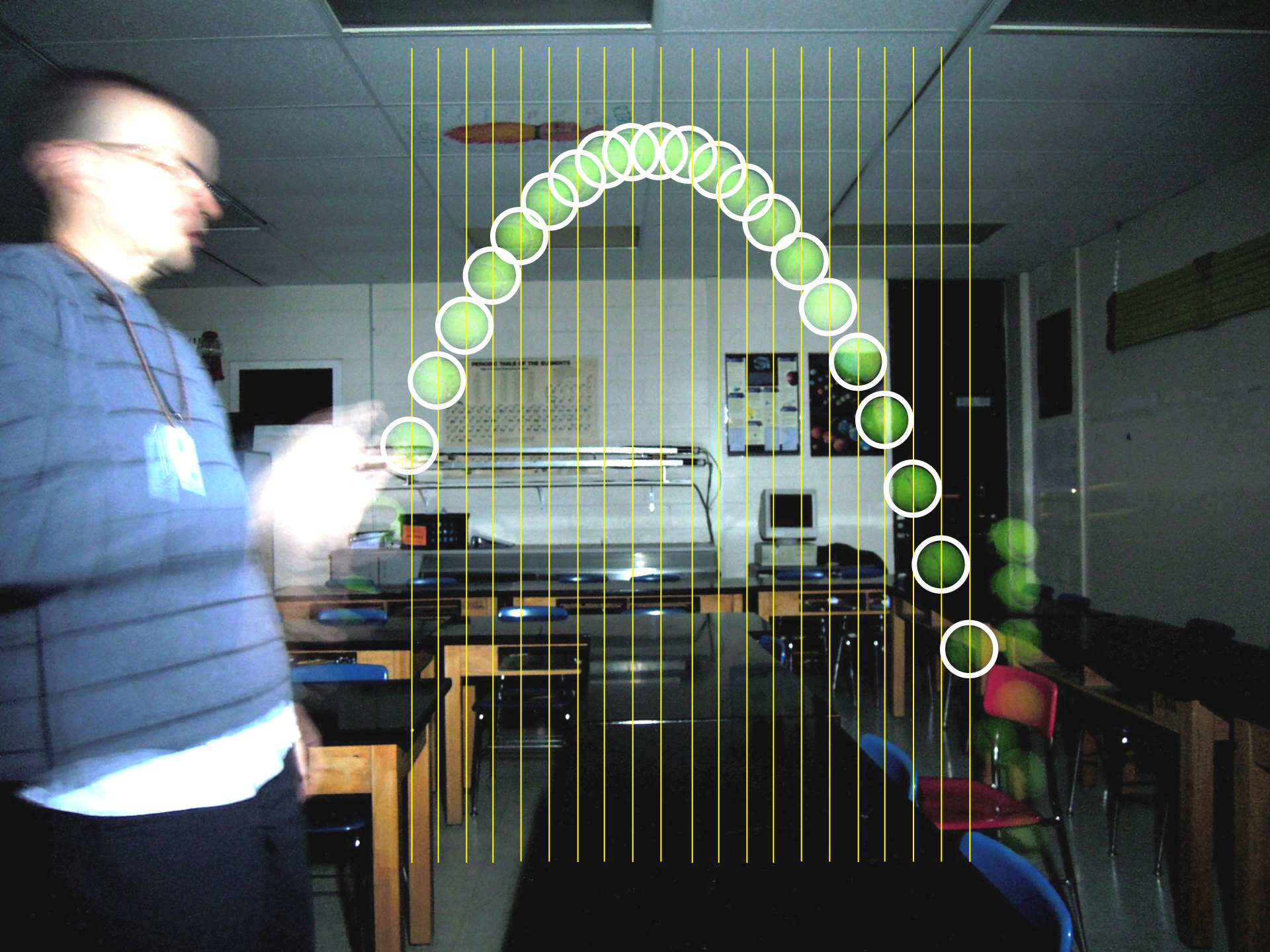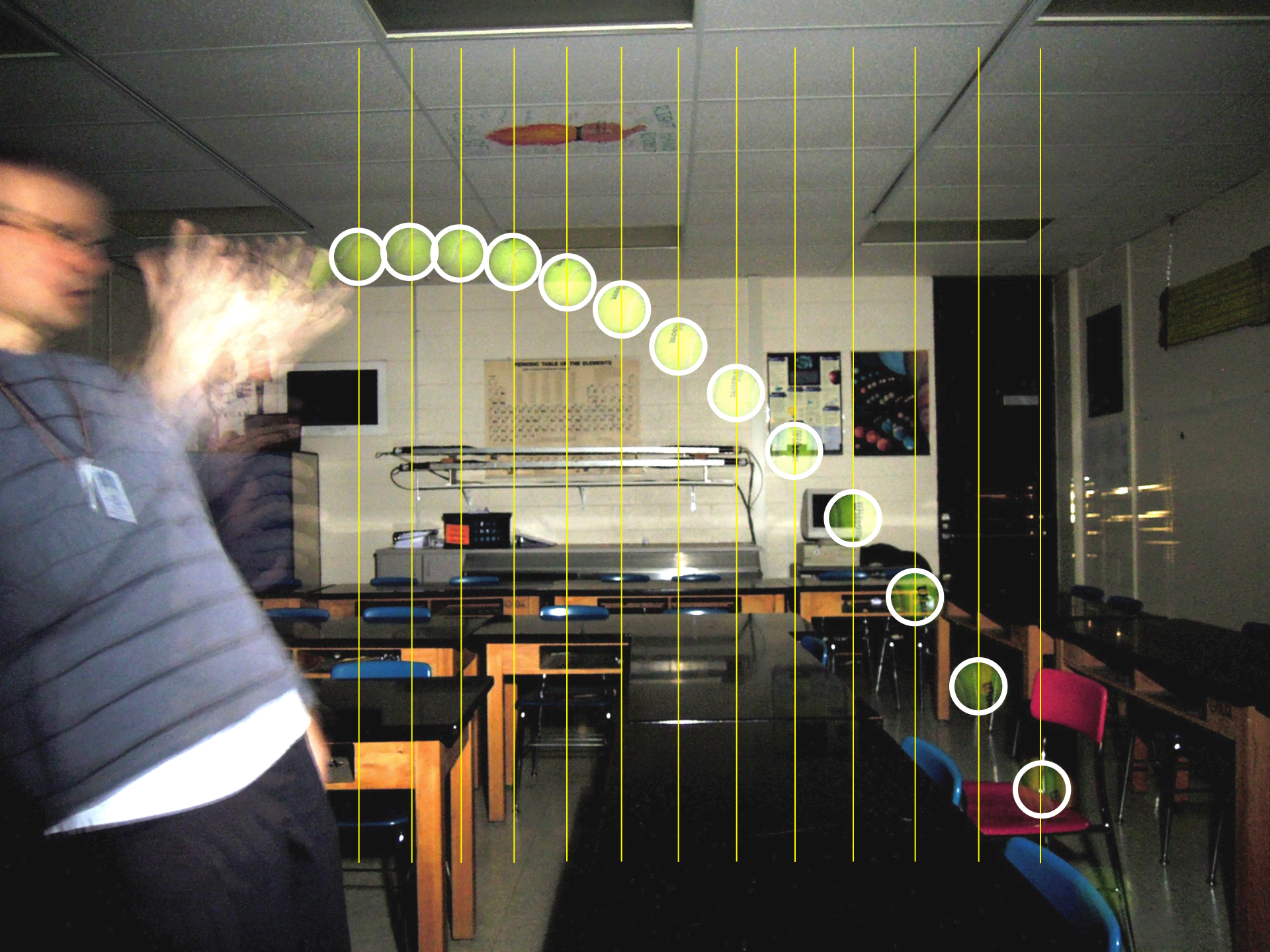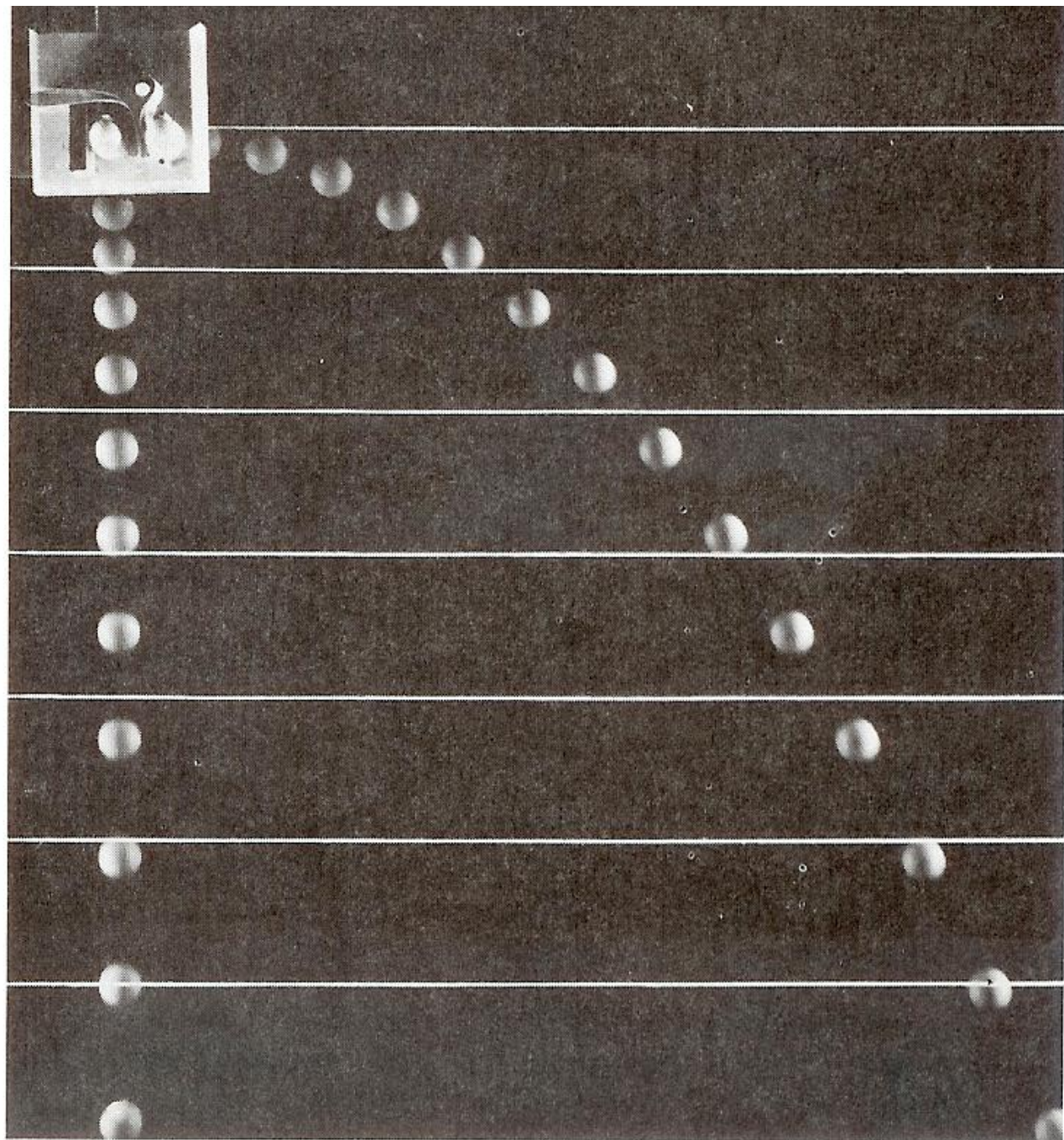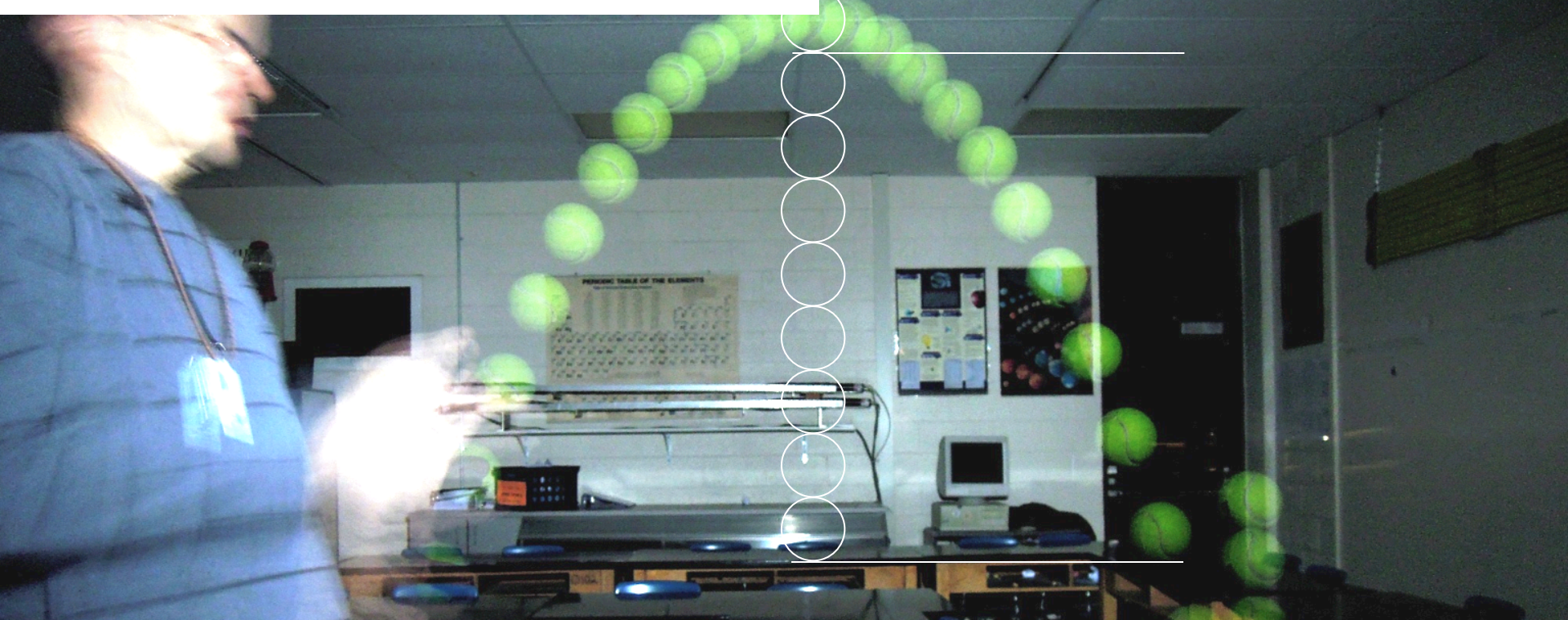
Projectile *x* and *y*

- Horizontally a projectile moves with a constant velocity. Velocity is constant in the *x*-direction.

Diameter of ball: 6.7 cm
Strobe: 1800 flashes/minute

The ball has fallen 8 diameters after 10 flashes of the strobe light.

What is its vertical acceleration?

Projectile *x* and *y*

- Horizontally a projectile moves with a constant velocity. Velocity is constant in the *x*-direction.

- Vertically a projectile moves with constant acceleration. Acceleration is *g* in the *y*-direction.

- The forward motion of a projectile does not alter the effect of gravity – nor does the force of gravity alter the forward motion of a projectile.

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

$$a_x = 0 \qquad\qquad a_y = -g$$

$$v_{fx} = v_{ix} + a_x t \qquad\qquad v_{fy} = v_{iy} + a_y t$$

$$d_x = v_{ix}t + \frac{1}{2}a_x t^2 \qquad\qquad d_y = v_{iy}t + \frac{1}{2}a_y t^2$$

Components of Projectile Motion

Horizontal

$$a_x = 0$$

$$v_{fx} = v_{ix}$$

$$d_x = v_{ix}t$$

Vertical

$$a_y = -g$$

$$v_{fy} = v_{iy} + a_y t$$

$$d_y = v_{iy}t + \tfrac{1}{2}a_y t^2$$

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$\mathbf{a}$

v_{fx}

$\mathbf{d}$

v_{fy}

$\mathbf{v}_f$

$\mathbf{v}_i$

v_{iy}

d_y

v_{ix}

d_x

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