September 26, 2013  Physics 131  Prof. E. F. Redish

- **Theme Music:** Soul II Soul
  *Keep on Movin’*

- **Cartoon:** Bob Thaves
  *Frank & Ernest*

**Frank and Ernest**

"The laws of motion is a little dry for a title, Mr. Newton. How about something catchier like "When push comes to shove"?"

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**Quiz 3**

Avg. = 5.8

- **A,B,D** 1%
- **A,C,E** 2%
- **B,E** 14%
- **D,E** 1%
What have we learned?

- **Position**
  \[ \hat{r} = x\hat{i} + y\hat{j} \]
  (where \(x \) and \(y \) are signed lengths)

- **Velocity**
  \[ \langle \vec{v} \rangle = \frac{\Delta \hat{r}}{\Delta t} \quad \vec{v} = \frac{d\hat{r}}{dt} \]

- **Acceleration**
  \[ \langle \vec{a} \rangle = \frac{\Delta \vec{v}}{\Delta t} \quad \vec{a} = \frac{d\vec{v}}{dt} \]

- **Seeing from the motion**

- **Seeing consistency (graphs & equations)**

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The Free Body Diagram

We want to understand & calculate what causes the motion of one of the objects, the ball.

**Draw a Free Body Diagram for Ball**

\[ \vec{F}^{\text{net}} = ?? \]