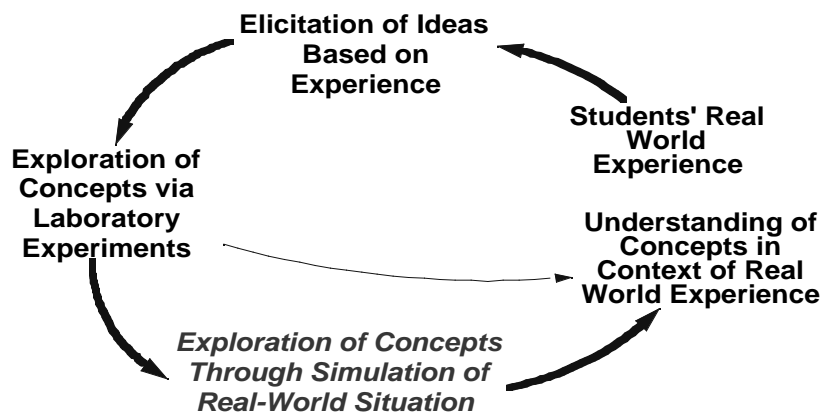


Using Dynamic Simulation as a “Real-World Laboratory for Teaching Physics

Presented by Gary B. Hirsch
Creator of Learning Environments
at Systems Thinking/Dynamic Modeling
Conference--July 1, 2002

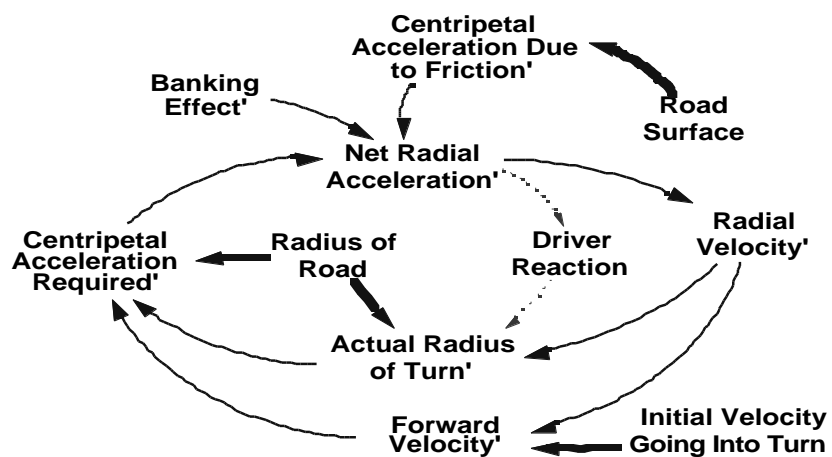
Relationship of Simulators to Active Physics Curriculum



Four Applications Developed in Connection With Active Physics Curriculum--Can Also Be Used as Freestanding Labs with Other Texts

- Travel Around a Curve and Stopping Distances
- Collisions
- Heat Flow and Home Energy Conservation
- Pole-Vaulting

Structure of the Model Underlying the Travel Around a Curve Simulator



Input Screen for Setting Up Experiments

Results of Simulation Where Skid Occurs

Comparison of Trajectories with and Without Steering

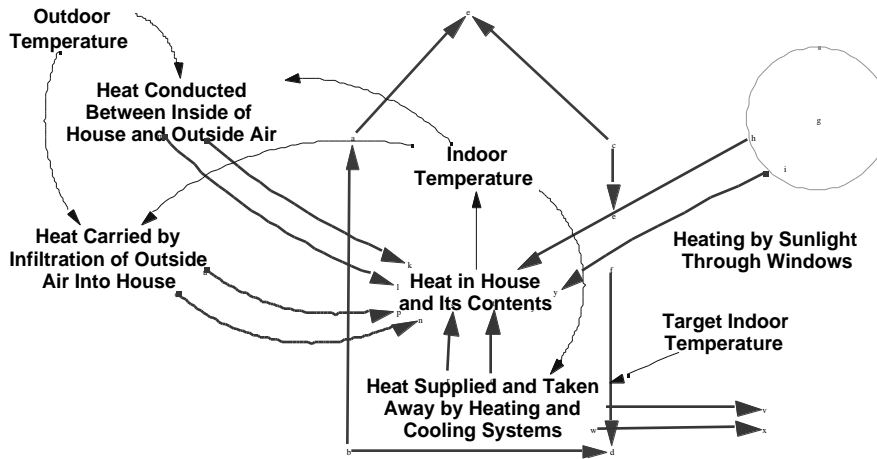


Tutorial Explaining the Effect of Steering in Worsening a Skid

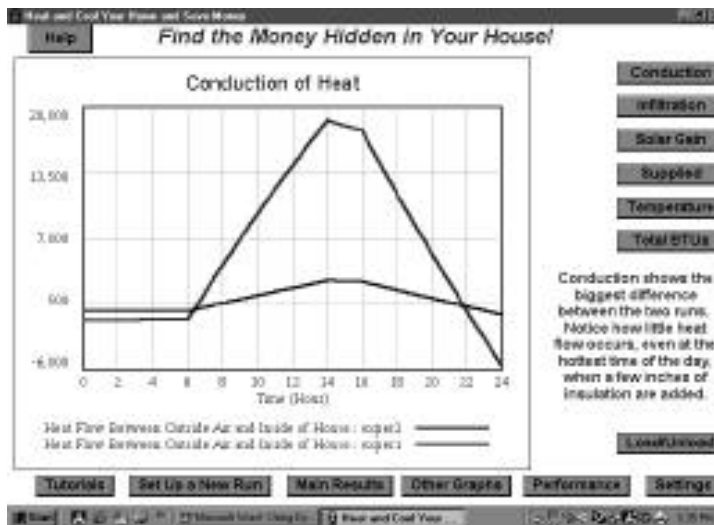
Why does steering back toward the road make things worse? The diagram at the left will give you a hint. If you enter a curve too fast, the car will begin to skid off the road and move in a Trajectory with a larger Radius. This will go on until equilibrium is reached—the Radius of the Trajectory becomes large enough for the Forward Velocity and Friction to hold the car in this larger Trajectory.

Steering back toward the road has the opposite effect. As you can see on the diagram, that turn has a very small Radius, much smaller than the equilibrium Radius and also smaller than that of the Road itself. The small Radius of this turn creates a larger Centripetal Acceleration Required that, in turn, makes the car harder to control. This turn can cause the car to swing in a wider arc.

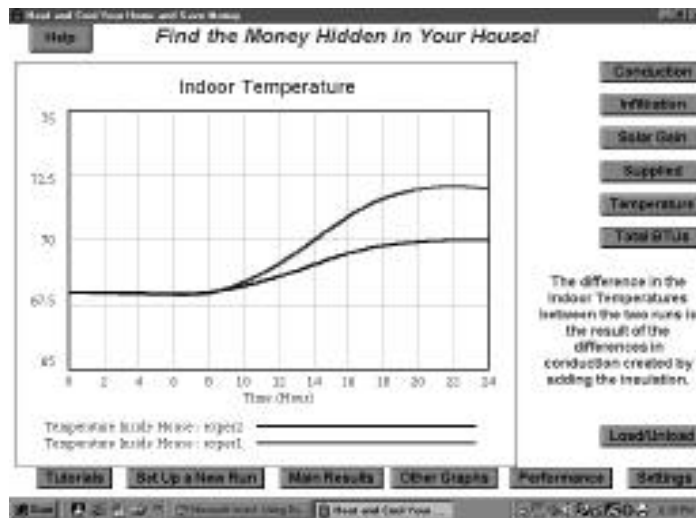
Determinants of Heat Flow Into and Out of a House



Heat Conduction and Temperature Change on a Summer's Day-- With and Without Insulation (1)



Heat Conduction and Temperature Change on a Summer's Day-- With and Without Insulation (2)



Input Screen for Heating and Cooling Experiments

Find the Money Hidden in Your House!

North:

Latitude:

Square Feet:

Stories:

Quality of Construction: Drafty 1980's Average Better Energy Efficient Airtight

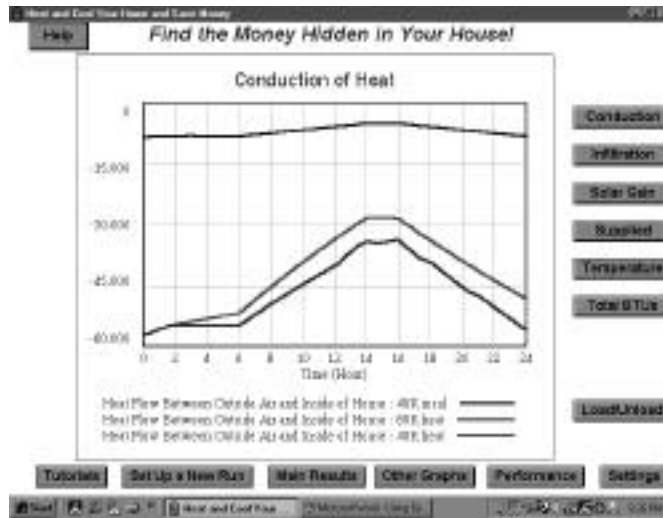
Provide Heating and Cooling?: No Yes

Set Heating and Cooling Capacity (BTUs per Hour): Heating Cooling Or Have Model

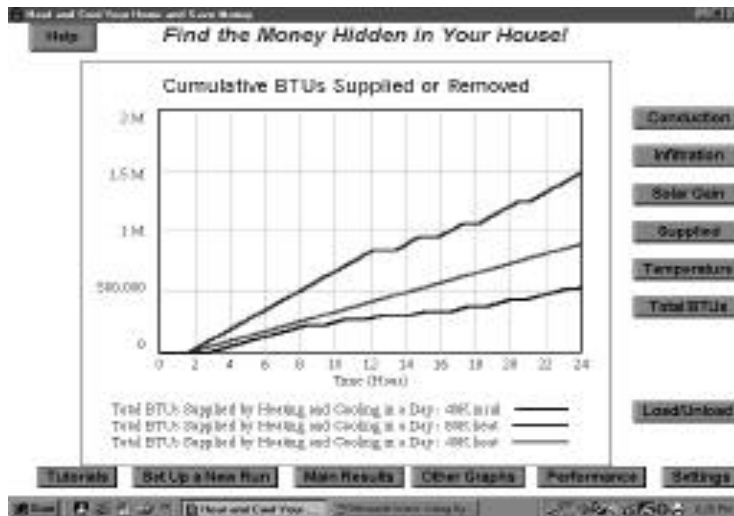
Thermostat Setting:

Experiments:

Results of Simulations with Different Heating Systems and Insulation (1)



Results of Simulations with Different Heating Systems and Insulation (2)



Economic Implications of the Three Simulations

Heat and Cool Your Home and Save Money			
Find the Money Hidden in Your House!			
	40K Insul	80K heat	40K heat
Total Heating BTUs	886,000	1.48 M	886,000
BTUs/HDDRSq. Ft.	8.773	24.26	14.67
Daily Heating Cost	7.031	19.45	11.75
Annual Heating Cost	\$72.08	2,689	1,626
Total Cooling BTUs	0	0	0
BTUs/CDDRSq. Ft.	0	0	0
Daily Cooling Cost	0	0	0
Annual Cooling Cost	N/A	N/A	N/A
Capital Cost	964.31	0	0

* See the "Payback" Tutorial for More Info. on Using This Data

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