**Hovercraft activities with Reach for the Sky Program**

Tuesday, June 3, 2008

James Flaten (MnSGC), with Joel Donna (and other Reach for the Sky instructors)

9 a.m. to 1:30 p.m. (approximately)

423 Alderman Hall, St. Paul campus of U of MN

About 21 students in 7th and 8th grade students and their teachers from White Earth Reservation

**Broad outline – can be flexible**

* **Joel: General introductions and “Set the Stage” for the day/week**
* **More-specific introduction to hovercraft**
  + What they are.
  + What we can learn from them
    - Motion and force
    - Apply this knowledge to astronaut activities (today) and rocketry (starting tomorrow)
* **Activity 1 – build and operate mini-hovercraft**
  + Show one in action as motivation
  + Instructions presented orally, build in pairs
    - Collect materials
    - Puncture cap
    - Hot-glue cap to CD
    - Inflate balloon (NO SHARING!), twist, insert
    - Untwist to operate
    - Observe motion and discuss observations (general terms)
    - Deficiencies of design, esp. drag when balloon falls over
  + Design challenge
    - improve on design for distance races
    - Do races (not particularly competitive)
    - Discuss result
* **Activity 2 – build large hovercraft** *(at some point tell them each school keeps one)*
  + Show one in action as motivation
  + Instructions to build on paper (**Joel**: break into 4 groups, with at least 1 adult in each group)
    - Show instructions and status of boards
    - Show tool collection and name tools
    - Collect materials
    - Borrow tools as you need them (name them?); return promptly
    - Try it out; troubleshoot as need be
* **Activity 3 – using hovercraft to discover (or verify) Newton’s Laws of Motion**  *(ask teachers how much they have studied motion/Newton’s Laws (if at all))*
  + Preamble
    - How hovercraft works – blower lifts board on cushion of air
    - What is special about it – motion in the absence of friction
    - One way to understand how things work is to observe their motion and how forcing (e.g. pushing) on an object affects its motion. Some early thinkers from Europe:
      * Aristotle (Greece): Force is required for motion. You need to push on something for it to move. If you stop pushing, it will immediately stop. Hence the most natural state of motion for objects is to be at rest (i.e. not moving).
      * Galileo (Italy) then Newton (England): Friction is a (passive) force that can push on things too. Without friction one can see more clearly the true “natural state of motion” and how force is related to motion. Rules are different from Aristotle!
  + Use your hovercraft to come up with new “Laws of Motion”. Here are some questions to consider. (Stick to translational motion; revisit rotation later.)
    - If an object is at rest, what does it tend to do?
    - What are various ways you can get an object moving?
    - If an object is moving (say “due north at 2 m/s), what does it tend to do?
    - What are various ways you can change the motion of a moving object?
    - How can you accurately study (i.e. quantify) the motion of an object?
    - How does the motion change (or the amount of force needed change) if you have more mass on the hovercraft?
  + Share your group’s observations
    - List ideas
    - Perhaps redo some experiments as a large group
    - Try to distill into Newton’s Laws, especially first Law
    - List Newton’s Laws in plain English and get reactions to them
    - Point out that the same ideas apply to rotational motion; demonstrate
  + Point out that this is (part of) the scientific method – doing experiments and distilling observations into general rules; next use this knowledge for applications

*Break for lunch? Maybe show the human-powered hovercraft video clip during lunch.*

* **Activity 4 – Hovercraft Astronauts**
  + Show poster of MN Space Grant activities
  + Go through Powerpoint presentation on Hovercraft Astronauts and STEM
    - Demonstrate bicycle wheel for attitude control
    - Demonstrate fire extinguishers for propulsion (only 2 seats available)
    - In your team, come up with an instruction set (to give to someone else?) for a rendezvous and docking scenario
    - Demonstration them to one another – take your time; this is not a race
  + Finish up slides
* **Joel: End-of-activity recap and looking forward….**