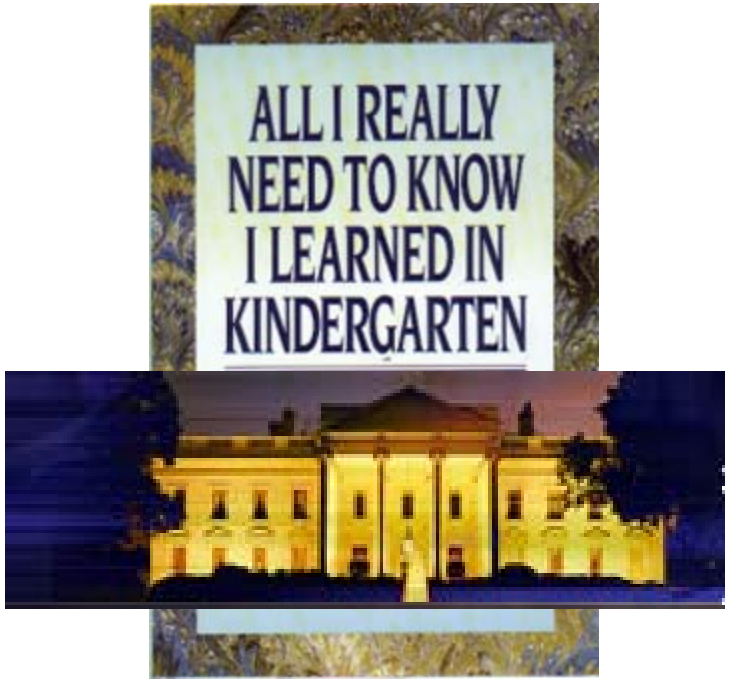
Everything I Needed to Know (About Science Policy), I Learned in High School



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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Two-bit summary

- "People with opinions just go around bothering each other."
  - Buddha
- "I long to accomplish some great and noble task, but it is my duty to do each small task as if it were great and noble."
  - Thich Nhat Hahn (also Helen Keller)

➔Washington, D.C., is a bother

➔There are lots of small and noble tasks to be done

Another two-bit summary

- The Executive Branch (aka the White House) is more powerful than one might initially think
  - e.g., witness the current Administration
- U.S. federal policies for science are, perhaps, the most rational and therefore the easiest place to get started in understanding the policy-making process
  - But that's not saying much!

Model West Wing (1)

- Illinois Mathematics and Science Academy (IMSA)
  - My high school in Aurora, Ill.
  - State-funded, residential magnet school (brainchild of Gov. Jim Thompson and long-time science education patron, Leon Lederman)
  - Students are ***gasp*** well-behaved teenagers who are interested in learning and have already admitted to themselves and their peers that its okay to like books, computers, numbers, ideas, …
  - Confession: teachers at this school are spoiled!

- My high school recently launched an "Intersession" program
  - Scaled down from the collegiate version, students return a week early from winter break to take a short course for 5 days
  - Alumni are invited to submit proposals to teach one of the classes

Model West Wing (2)

- On a lark, I submitted a proposal for a class that would role-play the Executive Branch development of national science policy
  - There are too many legislative branch role-playing games!
  - A favorite TV show, NBC's "The West Wing," had fallen off the air
- Proposal was accepted and 15 students signed up
  - Surprising! Competing classes included "Tour of Paris Art Museums," "Dance Lessons in Ibiza," and "Swimwear Design: Field Trip to Miami Beach."
- I drafted a detailed lesson plan for each of the 5 half-day sessions
  - Each class included lecture, group discussion, role-playing, and DVD excerpts from *The West Wing* TV series

Model West Wing (3)

- Students were mostly sophomores (three juniors)
- They knew nothing …
  - How much of the newspaper did YOU read when you were 14 years old?
- …But learned very quickly!
- As a result, I spent every waking minute (and then some) after each class revising the next day's lesson plan
- On the first day, the students were lethargic and responsive
- By the third day, they were shouting out answers, rushing to work in teams, and telling me how to structure their time
- The reason I'm here today is because these quite inexperienced youths taught ME a lot about science policy…

Formulating nat'l science policy w/14-yr olds

- Day 1: Define government, politics, policy, budget, and science
- Day 2: Identify and prioritize national science priorities
- Day 3: Formulate agency budgets to address the priorities
- Day 4: Emulate OMB passback and negotiations
- Day 5: Write "State of the Union" text to sell the overall program
  - Bonus Round: Compete for a federal contract to implement a program addressing one of the priorities

Day 1: Why – at all?

- First defined government, politics, policy, and science
  - "Science" was the hardest one to define!
  - For our purposes, we assumed that science = technology = basic = applied = R&D
  - Attempted to define politics as a *process for making group decisions*
- Next, small groups each addressed two key questions that would frame the entire exercise:
  - What is the value of science?
  - Why should the USG be involved in science?
- Students had a large variety of accurate and inventive answers
  - This is when I started to get worried!

Day 1: Why – do science?

- Can help improve quality of life and standard of living
- Practical applications
  - Defense: weapons, protection, detection
  - New technologies
  - Medicine and healthcare
- Produces and provides jobs: creates and makes new jobs (e.g., internet)
- Key to progression and advancement
  - Intellectual aesthetic (learning more about our world)
  - Increase efficiency and productivity
- Controlling our world
  - Provide means to attaining goals
  - Can even enable new science
- Protection, defense, homeland security

This is what THEY said is important

Day 1: Why – a nat'l science policy?

- Since science is not necessarily always good or positive, govm't needs to regulate and set standards; ethical questions may require legislated, moral stances
- S&T can provides ways to enforce other rules and laws
- Transitive axioms
  - Govm't wants to improve lives, science can improve lives, therefore govm't should be involved in science
  - Jobs are good, science can provide jobs, therefore govm't should be involved in science
- Science can create conflicts
  - Govm't should be involved to mitigate and negotiate
- Science affects economy
- Public interest (by citizens)
  - Cultural vitality and interest
  - Secure public resources
- Saves lives

This is what THEY said

Day 2: Top-level S&T priorities (1)

- Using the "store manager" analogy, we learned about the Executive Branch and EOP, Cabinet agencies
  - President is Sam Walton, Cabinet heads run the different retail sections of the store
  - Budget formulation is process of developing a year-long business plan of expected sales, inventory needs, and operating costs
- Broke into three groups and each identified 6 priorities for the "national science program" in FY2009
  - "What should the United States do in science?"
- Pretended this process was akin to that which led to OMB/OSTP "priorities memo"

Day 2: Top-level S&T priorities (2)

- Of the 18 proposed S&T priorities, the most innovative were
  - Hierarchical organization using themes of "connecting people," "alternative energy," and "21st century learning"
  - Sub-orbital transporter
  - Colonizing the moon
  - Game theory and decision analysis

- As a group, we then winnowed the 18 down to a set of 6
  - After selecting four, the students actually realized that its far easier to shoot down ideas individually (and in isolation) than to come up with them!
  - So we selected a "political process" of instant run-off voting to select the fifth and sixth priorities

Day 2: Top-level S&T priorities (3)

- Energy generation and efficiency ("enviro")
  - Looming specter of climate change and dependence on oil call for development of alternatives sources of energy and of higher efficiency existing technologies
- Science education
  - Because science & technology literacy is increasingly important for success in the modern world and because science shapes the future, attracting students to STEM and improving their education is critical.
- Medical R&D for cures ("bio")
  - Individuals health and wellness are still regularly ravaged by diseases, both old and new. Biomedical research programs are needed to develop new diagnostics, new cures, and new clinical treatments.
- Nanotechnology ("nano")
  - Controlling the nanoscale may hold the key to revolution in everything from materials science, next-generation computers, or even nano-robots that heal you from the inside.
- World hunger
  - Hunger and malnutrition continue to be a major cause of human suffering around the world. A renewed science & technology emphasis can address the short- and long-term roadblocks.
- Infrastructure for wireless internet access ("info")
  - The internet has revolutionized how people connect with one another and how Americans do business; yet the "digital divide" persists, now dramatized by the relatively limited availability and restricted access to wireless networking resources.

- Afterward, we compared our list to the memos from the past 3 years
  - Familiar, eh? Nano, info, "bio," and enviro!
  - Educo?

This is what THEY said

Day 3: Agency budget formulation (1)

- This step was tricky! Many of the students had never balanced a checkbook although they could compute binomial coefficients in their heads…
- We modeled the agency budget formulation process as a "shopping trip" with a fixed spending cap at the "science programs and facilities" store
- Based on the six national science priorities, we adopted NSF, DOE, and NIH as the three agencies we would role-play
  - 3 agencies = three different groups
  - I generated a shopping scenario for each agency, loosely inspired by reality

Day 3: Agency budget formulation (2)

- Each agency had an FY2009 allocation
  - NSF, $5B; DOE $6B; NIH $25B
- Each agency had about 2/3 of the budget potentially tied up in “ongoing programs”
  - NIH faced a “budget cut” from $30B in FY2008 to $25B in FY2009
  - The “ongoing programs” nearly completely filled the FY2009 allocation
- Each agency had a long list of options (whose total cost far outstripped their budget) on which to spend their resources

Day 3: Agency budget formulation (3)

- The "shopping lists" were tailored to each agency but included some quagmires for everyone
  - Public vs private funding
    - NSF considering system of seismographs and satellites to locate new oil fields; could partner 50% with NASA.
  - Continuing program vs new initiatives
  - Short vs long-term budget impact
    - Projects whose next-year cost was much different than the last-year cost
  - Certainty of projected costs
    - Several projects were off-budget and behind schedule
  - Collaboration with other agencies
    - Both DOE and NSF each had options to collaborate with NIH on genome mapping experiments
  - Projects with varying degrees of relevance to the science priorities
    - NSF had extra-solar planet searches to consider
  - Discrete vs continuous
    - Individual investigators vs new big projects

Day 3: Agency budget formulation (4)

NSF
- Business as usual
- Cancelled plans for nat'l eco monitoring system
- Oil exploration w/NASA
- Collab w/NIH on genome mapping
- Worlwide supercollider
- Hydrogen fuel cell
- Research on STEM ed
- Collab with NIH, DOE, to train doctors in physical science
- Targeted research in medical nano, nano for defense, world hunger, wireless inf
- Energy conference

DOE
- Business as usual
- Nanoscience center
- Nuclear fusion research
- STEM Ed
- Materials science Ed
- Worlwide supercollider
- Collab with NIH, NSF, to train doctors in physical science
- Targeted initiative in wireless networking infrastructure
- Rare-isotope experiment at university

NIH
- Business as usual with $5B cut
- UN program on hunger
- Nanorobots for health
- Researchers to elem. schools
- Drug dev partnerships on depression, Alzheimer's
- Collab with DOE, NSF, to train doctors in physical science

This is what THEY said

Day 4: Passback and negotiation (1)

- So what? Kids can buy things! They all have credits cards now, right?
  - Even so, only one agency killed an existing project
  - Even so, NSF and DOE chose smaller university-research programs and aimed for big projects
  - Even so, every agency initially bought a "3-agency collaboration" to train medical doctors in the physical sciences
  - Even so, DOE and NSF bought nano and hydro(gen) big time
  - Even so, DOE bought RIA @ MSU b/c of the science education impact
  - Even so, DOE and NSF each (and separately) bought into the ILC
  - Even so, NIH avoided any bio/enviro/eco projects as well as human-health studies about the consequences of certain science priorities
  - Even so, NIH jumped at chances to collaborate/leverage with drug companies

- ➔To emulate the first stage of passback, we put all three agency budgets on the board and started asking questions as a group…

Day 4: Passback and negotiation (2)

- Q1: The DOE proposal includes both a domestic and an international fusion program; why is this not duplicative and what is the relationship?
  - The DOE group, with some struggling, actually hit upon the right answer!
- Q2: Why is DOE doing things that aren't energy related, such as the wireless internet infrastructure initiative?
  - Besides the fact that one of the students who proposed it as a nat'l science priority was on that team?!
- Q3: Why is DOE not collaborating with other agencies as much as NSF and NIH are? That's not fair.
  - How come DOE and NSF are NOT collaborating on other projects?
  - Why is DOE trying to address ALL the science priorities all by themselves?
- Q4: Why doesn't NIH trim their "advertising, marketing, and admin" overheard to free up resources for science? How many anti-cancer TV commercials are really necessary? Who has demonstrated their impact?

This is what THEY said

Day 4: Passback and negotiation (3)

- Q5: Why is NSF involved in oil exploration at all?
  - Shouldn't the private sector handle that and shouldn't the govm't be working on long-term solutions? What are the strategic implications of the deployment of federal science agencies on the right or wrong energy questions?
- Q6: Why are DOE and NSF each supporting the ILC?
  - Several students rationalized as "we each bring something different to the table and each of respective communities need to be involved."
- Q7: Why is everyone doing hydrogen research for alternative energy?
  - How broad should the alternative-energy portfolio be? Can we invest in too many things at once so that "we're spread to thin" or are we putting too many eggs all in one basket?

This is what THEY said

Day 4: Passback and negotiation (4)

- We made some adjustments to the agency budgets as a group
- Liberally rewriting history, “the President created an Initiative for a Competitive America”
  - DOE and NSF received 10% more $$ to spend during passback; NIH got nothing
- I structured this a bit carefully
  - Part 1: Asked the class if NIH should be a part of the discussion
  - Part 2: How are we going to allocate the extra budget authority?

Day 4: Passback and negotiation (5)

- In response to NIH question, the first answer was:
  - No, NIH should not participate and, in fact, they should be forced to re-evaluate their programs to see if they can give up more of their own funding!
  - I overruled and said that they had to be involved
- Effort to reallocate failed abysmally at first: 15 people talking all at once!
  - After 5 minutes, I halted the class and asked what was going on
  - They told me that their “political process” (some combination of anarchy and flat democracy) wasn’t working.
  - They PROPOSED a representative process whereby each agency would develop alternatives and then send a delegate to a negotiating table where discussions would take place.

Day 4: Passback and negotiation (6)

- Results, summarized
  - NSF and DOE rescinded their partnerships with NIH
    - Eventually, re-funded the collaborative project but made NIH pay the most
  - NSF expanded its big projects and didn't restore its cancelled program
  - DOE tried to tackle even more science priorities with other types of alternative energy and "gave" its hydrogen program to NSF
  - NSF adopted a "subminiature devices" program for DOD

Day 5: SOTU (1)

- The next step was to "frame" the national science program, now fully spelled out with concrete activities
- We generously assumed that the president would spend 5-minutes in the SOTU describing the nat'l science program
- Three groups each prepared a 5-minute speech
  - They complained and resisted…speech-writing is hard!
  - After a lesson on "framing," they did slightly better
- To different degrees, the speeches employed standard frames for science
  - "Social progress" frame: science bring cures, new technologies, better way of life
  - "Competitive" frame: if we don't do these investments, USA will fall behind
  - "Justice / morality" frame: it's the right thing to do to help us help the world

Day 5: Competitive sourcing (1)

- Final step, as a bonus round, was for two groups to develop a “bid” for a govm’t contract to construct one of the large facility projects and a third group to serve as the review panel
- We chose to bid on the hydrogen-fuel research program
- With relatively little guidance, the groups prepared ingredients for their proposals and criteria for the review panel

Day 5: Competitive sourcing (2)

- The two groups used different tactics
  - One sought to establish a long-track record of success and how close they were to breakthrough
  - The other said their staff was all Nobel laureates and presented more of a strategic and administrative plan

- The review panel selected a group although it was “a close call”
  - Remembering the priorities memos, they scored on “Quality,” “Performance,” and Relevance”
  - “Staff salaries” looked too big in the losing proposal
  - The losing proposal did not convince the panel that the whole team was engaged and sincere: the whole team didn’t speak up
  - Both groups appeared to make false claims and both claimed credit for having invented the hydrogen bomb!
  - The winning proposal had a timescale that sounded more realistic for the innovation and then the market penetration
  - The losing team spent too much time describing previous accomplishments and not enough on future plans: what was their budget justification?
  - The winning team had more credible claims to familiarity with hydrogen technology

This is what THEY said

Lessons learned

- The pathologies that we witness in national science policy appear to exist even in relatively uncontaminated high-school role-playing simulations
  - Business-as-usual
  - Territorialism
  - Jealousy / entitlement
  - Interagency collaboration is really hard
  - Understanding long-term commitments is hard
- However, on the other hand, these students were quite shrewd
  - Picked up on “What is the role of govm’t funding?”
  - For what reasons should agencies jointly participate?
- Who needs trained science-policy analysts when high-school kids can already do the job?!

Back-Up Slides

DVD Excerpt

NBC's "The West Wing"

Episode 35 – *Bartlett's 3rd State of the Union*

Defining Government

- What is a government?
  - "The organization, machinery, or agency through which a political unit exercises authority and performs functions and which is usually classified according to the distribution of power within it"
  - A system which exercises control and influences the activities of a group of people
- What are some reasons to have a government?
- What defines the U.S. government?

What is Politics?

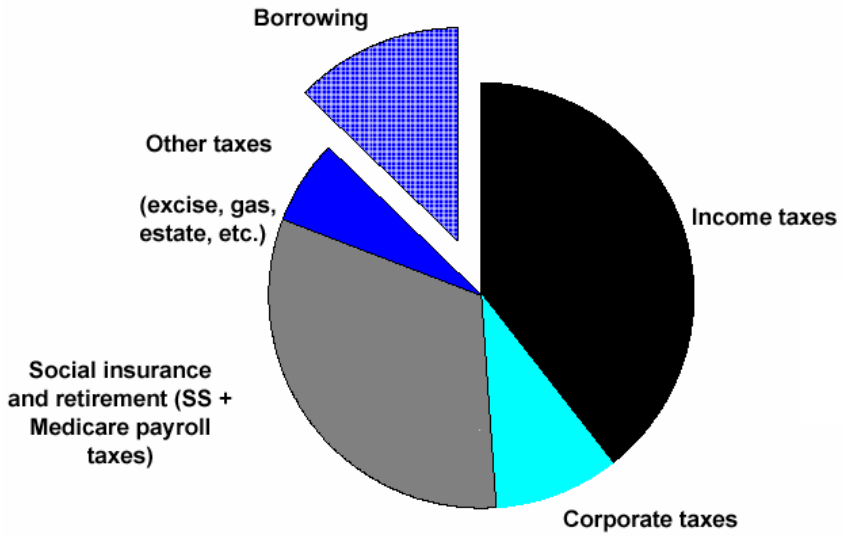
- The process by which groups make decisions
- The activity through which people make, preserve, and amend the general rules under which they live
- The process by which a community's decisions are made, rules for group behavior are established, competition for positions of leadership is regulated, and the disruptive effects of disputes are minimized.
- The process by which somewhat arbitrary decisions are reached about personal preferences among a number of parties where there is no absolute metric

Politics vs Policy

- In Washington, we often separate *politics* from *policy* (perhaps in a pejorative fashion)
  - Politics is the art of the politician: staying in office, negotiating compromises with colleagues, and so on
  - Policy-making is the science of identifying objectives for federal action and proposing actions to achieve them

Say that again?

Composition of the Proposed FY 2007 Budget by Source of Funds
Total Outlays = $2.8 trillion



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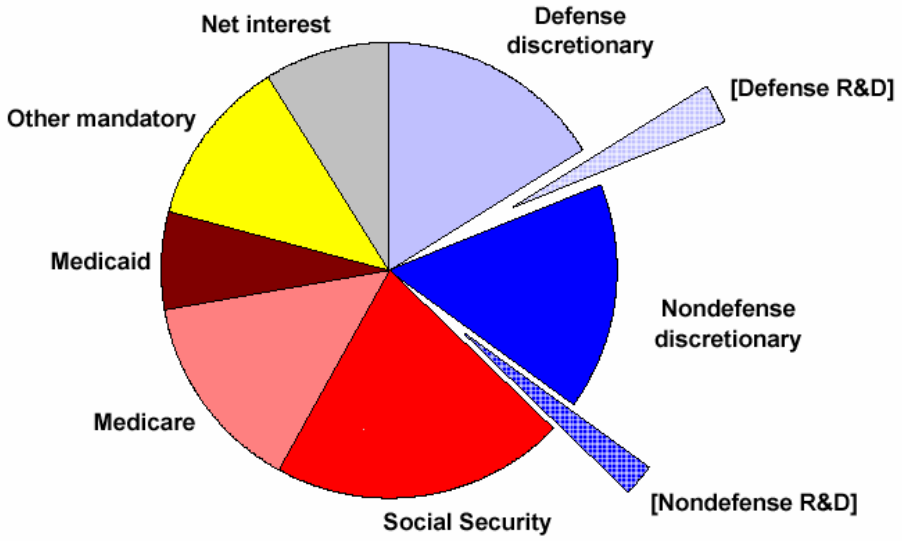

- **FY = Fiscal Year 10/1/2006-09/30/2007**

“Gillette® razor model” (1)

- A feature of program planning and budgeting that we mostly ignored yesterday was the difference between *building* something and *running* it.
  - When you buy a house, there’s the *capital* cost of the purchase. You could even finance the one-time cost with a mortgage to make it a long-term, recurring expense. After you buy the house, though, there’s the *operating* expenses of utilities, cleaning, home repair, and so on.

The human mind is not very attuned to separating these costs. “Can I afford the Ferrari? Well, I have $280k and that’s the sticker price, so okay.” But Ferrari mechanics charge an arm and two legs off that stallion to just change the oil!

- The commercial world has exploited this in a brilliant strategy…glibly named after the Gillette razor company

"Gillette razor model" (2)

- This business model is credited to King C. Gillette who developed it in the early 1900s
- The razor & blades business model works by selling an initial "master" product at a subsidized price, and making the profit on high margin "consumables" that are essential to the use of the master product. The master product may actually be sold at a loss, in order to "capture" the customer into using the consumable product.
  - Gillette regularly buys the names of young men passing through adolescence. Almost without fail, each young man receives a FREE razor in the mail near his 18th birthday…a perfect plan for getting them "hooked" on the disposable/refillable razor blades
- In 2004, Gillette expanded this business model with the M3Power, a vibrating safety razor with proprietary blades and standard batteries. While not a proprietary battery, it still benefits Gillette by expanding the consumer market for batteries…Gillette owns the Duracell brand!

"Gillette razor model" (3)

- And this is relevant because…the buck almost always stops with the U.S. govm't
  - So if the nation buys a razor, guess who has to ensure that there are always razor blades?
  - The Executive Branch!
- Real-world example
  - At a DOE laboratory in Long Island, there is a large particle accelerator that collides atomic nuclei with each other near the speed of light (gold smashing into gold at relativistic velocities!)
  - It is expensive to run
  - Because of budget negotiations for FY2006, the facility received essentially zero budget to run the machine (it was going to run 1 week)! The razor had been purchased, but no one had money to pay for the blades.
  - The laboratory director, a brilliant man, convinced a private foundation to contribute $13M so that the accelerator could run 20 weeks in 2006…