

# TABLE OF CONTENTS

<b>Program Overview .....</b>	<b>2</b>
<b>Goals.....</b>	<b>3</b>
<b>Benefits.....</b>	<b>3</b>
High school students:.....	3
College students: .....	3
<b>Teams .....</b>	<b>4</b>
Recruitment .....	4
Team Map .....	5
Student Demographics .....	6
<b>Mentors .....</b>	<b>7</b>
DeCal .....	7
<b>Season .....</b>	<b>8</b>
The Game: Pillow Fight .....	9
Kickoff .....	10
Work sessions .....	10
Design Reviews .....	11
Scrimmage .....	12
Final Competition.....	13
Testimonials .....	15
<b>Administration .....</b>	<b>16</b>
Kit Development .....	16
Mentorship .....	18
External Relations .....	19
Finances and Sponsorship.....	19
2011 Budget and Funding.....	20
Project Timeline .....	21
<b>Season Outcomes.....</b>	<b>22</b>
<b>Future Directions .....</b>	<b>23</b>
<b>Conclusion .....</b>	<b>25</b>



# PIONEERS IN ENGINEERING

## HIGH SCHOOL ROBOTICS COMPETITION

### 2011 SEASON REPORT

#### PROGRAM OVERVIEW



The Pioneers in Engineering (PiE) Robotics Competition for Bay Area high school students seeks to encourage interest and diversity in higher education. Founded in 2008, PiE is a science, technology, engineering, and mathematics outreach program that gives back to the local community. UC Berkeley students mentor local high school students as they design, construct, and program a mobile robot.

By providing a creative, low-cost, and hands-on after-school activity, PiE is able to bring a science and engineering experience to socioeconomically diverse and disadvantaged East Bay high school students. A key feature of the competition is the \$100 per team entrance fee, which ensures that finances are not a barrier to entry. Another central goal of PiE is to give UC Berkeley engineering students the opportunity to serve the local community while simultaneously gaining practical experience in hardware and software design as well as leadership and teaching. Promoting the future of engineering at the grade school level and encouraging professional development in college embodies the spirit of our parent organization, Tau Beta Pi.

# GOALS

1. Create and sustain a low-cost engineering education program to serve the socioeconomically diverse communities around the University of California, Berkeley.
2. Draw engineering students to community service that utilizes their unique skill sets.
3. Stimulate high school student interest in math, science, and engineering and the pursuit of degrees in those subjects at the University of California, Berkeley and other institutions.
4. Enhance the recognition of engineering and the University of California, Berkeley, in the community.

# BENEFITS

## HIGH SCHOOL STUDENTS:

- Design and build a robot for competition in a fun, exciting, and hands-on process.
- Face challenges and gain skills that are applicable in the real world.
- Develop a product, creating a sense of connection, pride, and ownership.
- Work with college mentors close to their own age.

## COLLEGE STUDENTS:

- Apply and hone expertise from engineering classes in a local community service project.
- Mentor high school students, playing a part in developing future engineers and receiving the opportunity to share their enthusiasm with a receptive audience.
- Practice professional skills while communicating and working with schools, teachers, the College of Engineering, and industry sponsors.
- Teach on technical topics and thereby improve their own understanding.
- Encounter many opportunities for leadership experience.



*Team 8 Oakland Tech student Lucas Chambliss explains a design drawing.*



*Team 12 Bishop O'Dowd's students Matthew Hallock (left) and Dean Tarpey (right) debug their robot with Mechanical Lead RJ Sheperd (center).*

## TEAMS

High school teams are the primary focus of Pioneers in Engineering. Comprising 5-15 students each, teams develop a robot that they build for competition. Most students meet with their team and mentors after school a few times per week — and more frequently as the competition approaches!

Drawn from local East Bay high schools, the teams in PiE 2011 included faces new and old. This year, we welcomed back Albany High, Berkeley High, and Bishop O'Dowd High and were excited to introduce teams from Acalanes High, El Cerrito High, Head-Royce School, Oakland Technical High, Pinole Valley High, and Ralph J. Bunche High.

## RECRUITMENT

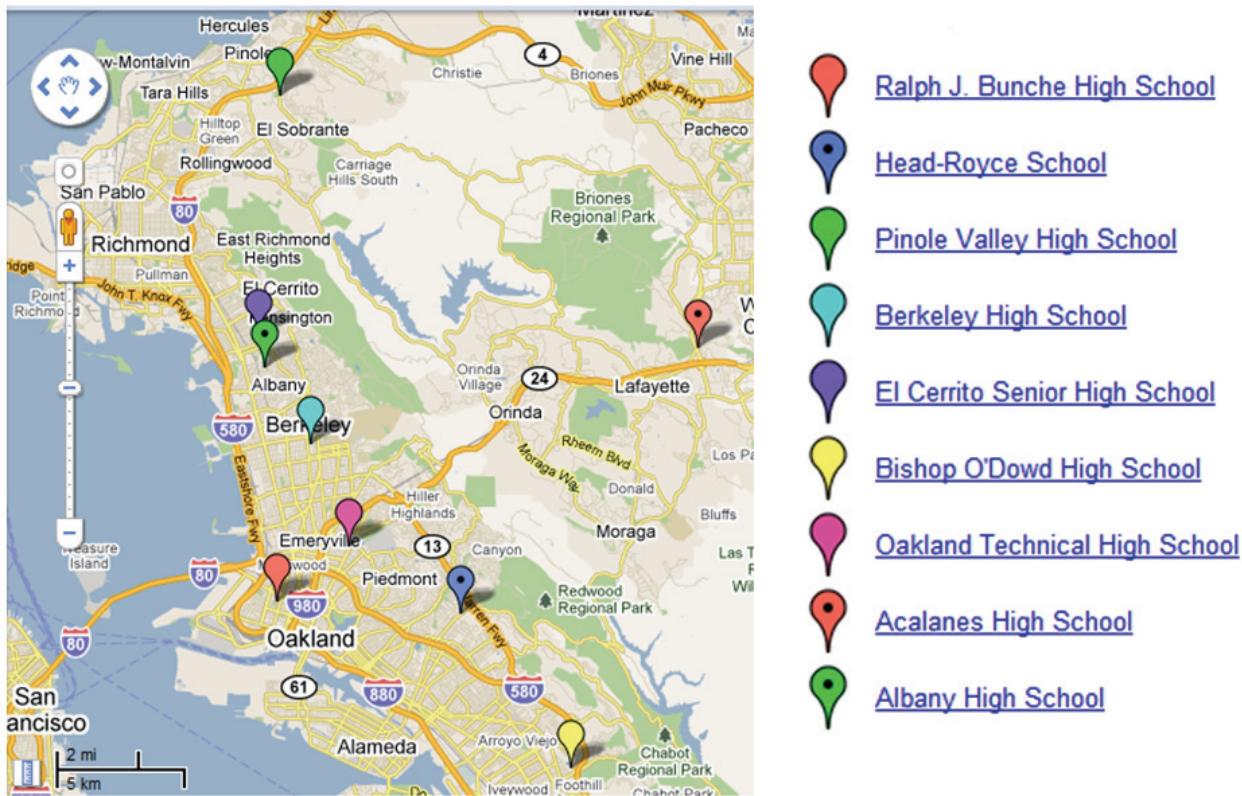
Teams were mostly recruited by contact with high school teachers, who leveraged their influence at school to bring together groups of interested students. On our part, outreach to teachers ramped up in January and continued until mid-February. Personal contacts, professional references, and word of mouth all contributed to crafting relationships with teachers. Overall, school recruitment was successful even to the point of threatening over-enrollment. Similar, controlled efforts should be made in future years to spread the word and target disadvantaged schools and students.



*Students Laurens Kuypers (left) and Amie Chou from Team 4 El Cerrito demonstrate a design mock-up.*

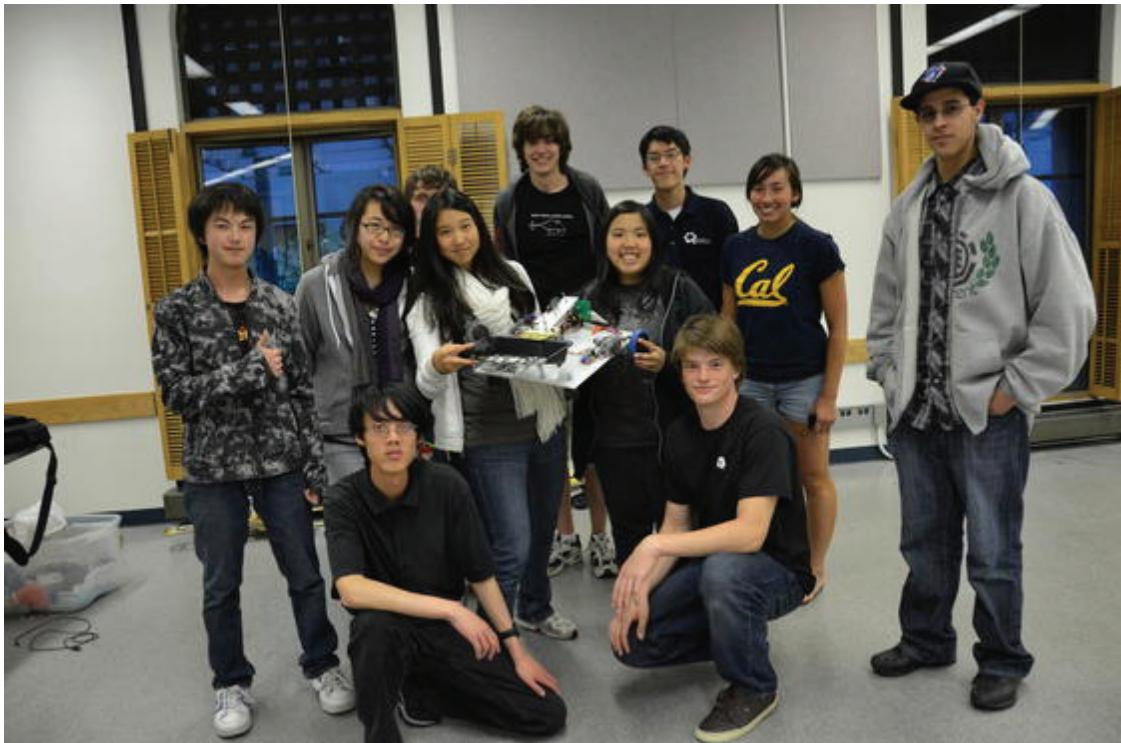
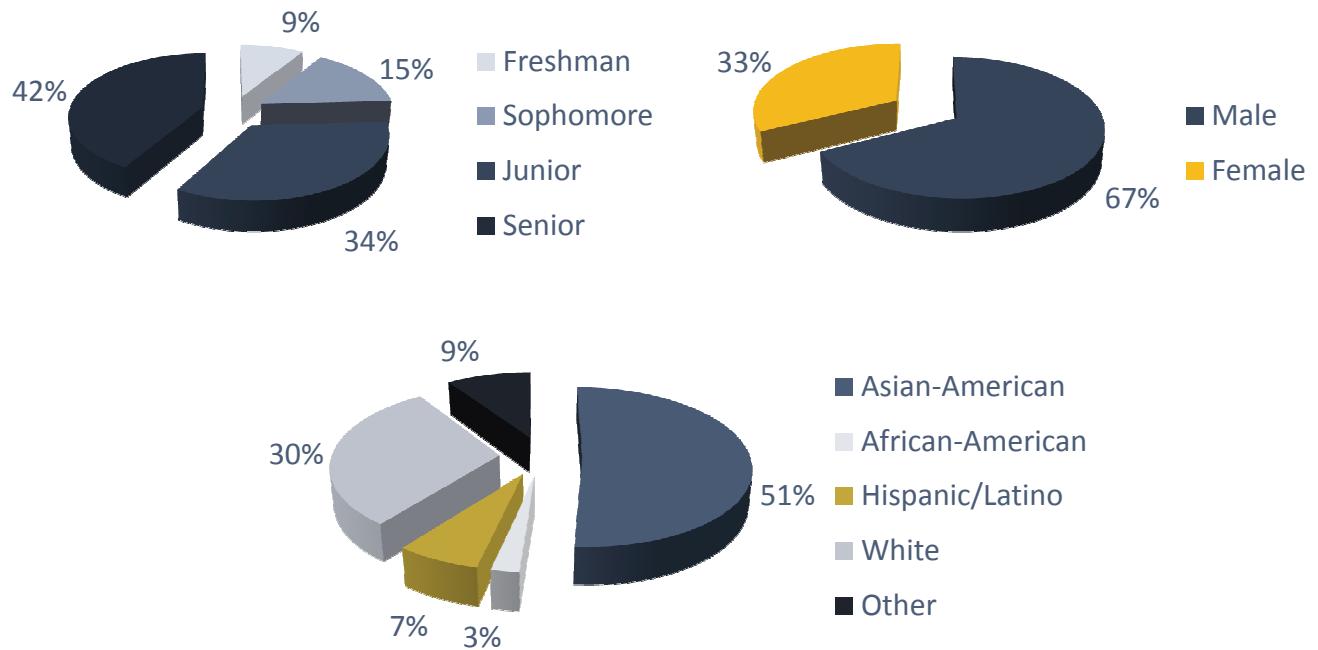
## TEAM MAP

A total of 12 teams were recruited from 9 schools in 5 districts.



SCHOOL	TEAMS	CITY	SCHOOL DISTRICT
Acalanes High School	1	Lafayette	Acalanes Union
Albany High School	1	Albany	Albany Unified
Berkeley High School	1	Berkeley	Berkeley Unified
El Cerrito High School	2	El Cerrito	West Contra Costa Unified
Head-Royce High School	1	Oakland	Independent
Oakland Technical High School	3	Oakland	Oakland Unified
Pinole Valley High School	1	Pinole	West Contra Costa Unified
Ralph J. Bunche High School	1	Oakland	Oakland Unified
Bishop O'Dowd High School	1	Oakland	Independent

## STUDENT DEMOGRAPHICS

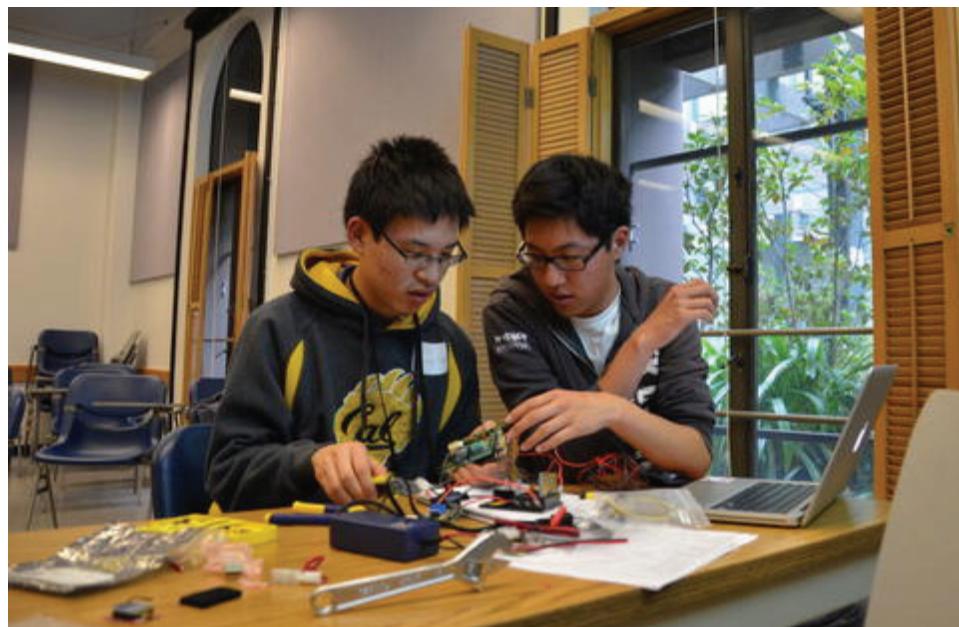


*Team 5 El Cerrito smiles for the camera. Can you spot the mentors? It's tough!*

# MENTORS

Mentors are university students who volunteer for PiE during the competition season, acting as guides, technical advisors, discussion leaders, and friends to the high school teams. There are no prerequisites to being a mentor, with the assumption that those who are interested are willing to put in the time and effort to learn. Mentors are assigned to teams at the beginning of the season and work with them at school and on campus until the Final Competition.

In total, there were 35 mentors for 12 teams in this year's competition, exceeding our target of two mentors per team and almost reaching our ideal goal of three. Two mentors attended nearby Berkeley City College, marking the first time PiE involved mentors from a college other than UC Berkeley. Some mentors were recruited from the Tau Beta Pi candidate class, but most came from the DeCal.



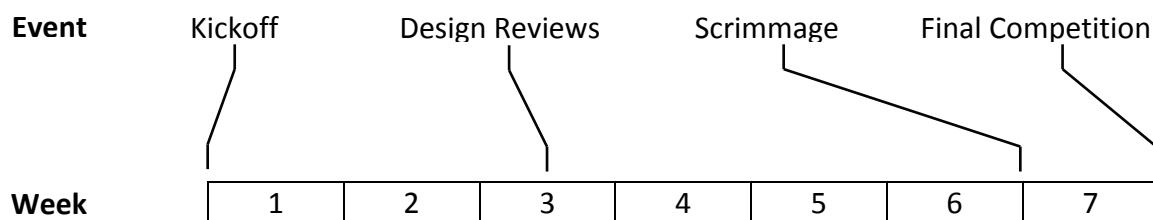
*Team 2 Albany student Daniel Xu (left) works on the kit electronics with mentor Cong Chen (right), himself an Albany student not long ago.*

# DECAL

Mentors for PiE 2011 were primarily recruited from UC Berkeley students through a student-facilitated course offering, or DeCal. The course syllabus was developed by PiE staff during the fall and was officially approved by the university as a course in the spring 2011 semester. The PiE DeCal was designed as a crash course in robotics, with hands-on labs that allow mentors to assemble, wire, and program a kit robot. With this experience under their belts, the DeCal mentors were more than ready to support their teams during the season.

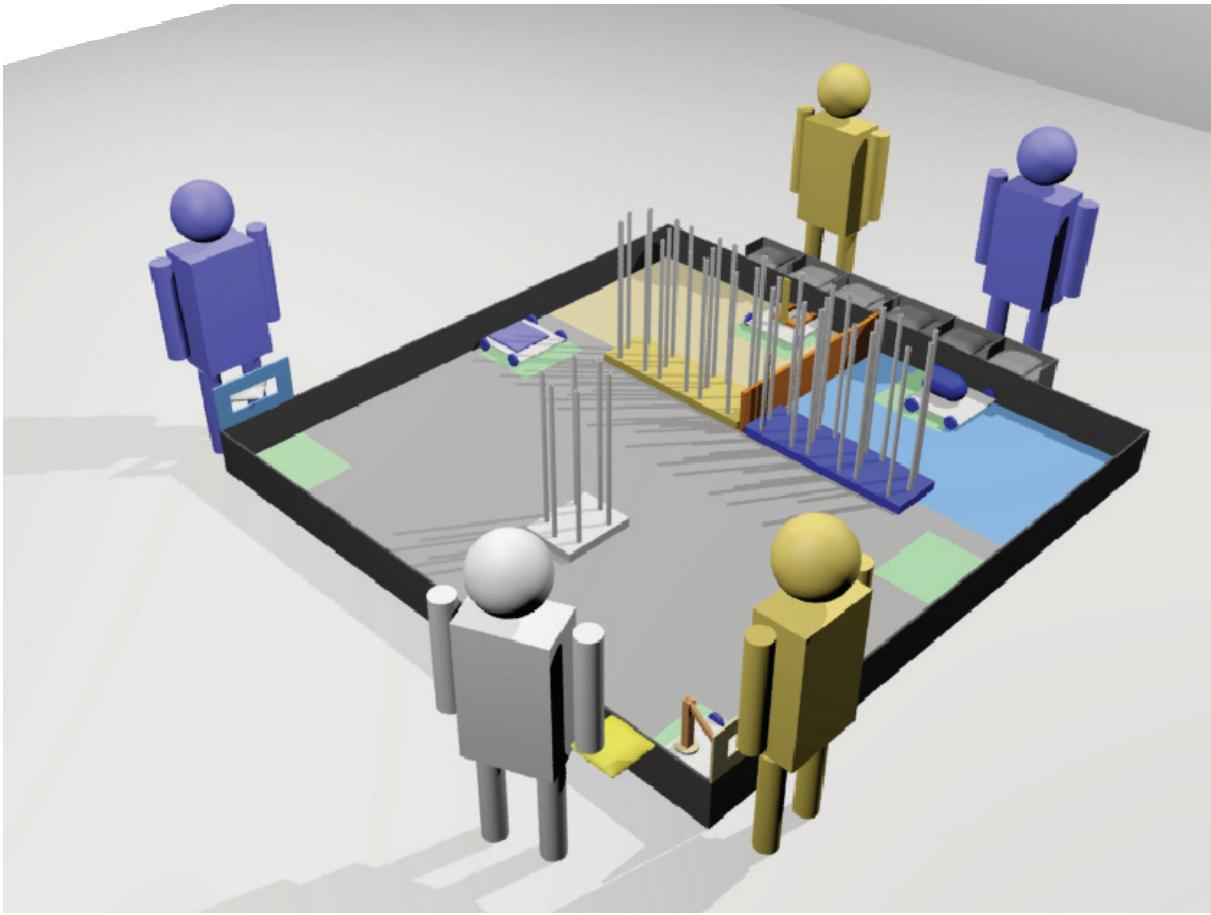
# SEASON

The seven-week competition season is the main focus of the PiE outreach program. The season includes a number of mandatory events; additionally, daily after-school work sessions were held on the UC Berkeley campus. All these events keep teams on track and enrich their experience. Of course, no competition is complete without a game. Each year, PiE staff design a new game to challenge the teams and their robots. This game is introduced at Kickoff and defines teams' efforts for the rest of the season.



*A typical day at a PiE work session.*

## THE GAME: PILLOW FIGHT



Pillow Fight is played by two opposing alliances composed of two teams each, in matches that are two minutes in length. The teams in each alliance score points and are assessed penalties as an alliance, not as individual teams. The object of the game is to score more points than the other alliance by placing pillows in goals around the field.

The 11 feet by 11 feet field is divided into two zones, the autonomous zone and the teleoperated zone. Inside the autonomous zone, robots score autonomous pillows using only on-board sensors and software. Upon scoring an autonomous pillow, the scoring alliance receives a bonus pillow to be used later in the match. Autonomous pillows cannot be scored outside of the autonomous zone.

In the teleoperated zone, robots are controlled via radio by robot operators from each alliance. Robots may score points by placing pillows into the colored alliance goals and the center bonus goal. Each teleoperated pillow placed in the bonus goal on top of a bonus pillow of an alliance's color will double the value of that teleoperated pillow.

## KICKOFF

To begin the season, Kickoff gives teams a running start. At the day-long event, teams receive their kits, learn about the game, meet their mentors, and start learning about and working on their robot.

Held on the UC Berkeley campus, 2011 Kickoff had an audience of over 100 high school students and 40 mentors. The day began with an opening presentation featuring mechanical engineering Professor Dennis Lieu and the Director of PiE, who welcomed teams and revealed the year's competition game. Teams were introduced to their mentors and received their kit with instructions for assembly. Following a lunch prepared by the PiE staff, students attended two sessions of three different workshops: electrical, software, and team management. These workshops familiarized teams with kit components and the process of running a team. The rest of the day was free for teams to meet their mentors, assemble the robot, and discuss the game.

Kickoff was a success, with improvements to be made in the future. Staff were not administratively prepared in the morning, so the check-in process was somewhat disorganized. Workshops, a new addition to Kickoff, were helpful and widely enjoyed. The electrical workshop was particularly popular, but software proved difficult to teach as the level of explanation was too modest for some students.



## WORK SESSIONS

During the 2011 build season, mentors were required to meet with their teams once a week, though most mentors met more regularly. To facilitate these meetings, staffed work session hours were held in O'Brien Hall on campus; staff helped students by answering technical questions and debugging problems with the kit.

O'Brien Hall became home for many teams during the seven-week build period. Containing cabinets with tools, spare parts and equipment and the knowledgeable PiE staff, work sessions at O'Brien proved to be some of the most helpful and productive events of the season. In the two weeks prior to Final Competition, every single team visited the work sessions to make sure their robots were prepared and ready to win.

*PiE Director Ryan Julian delivers the opening presentation at Kickoff 2011.*

## DESIGN REVIEWS

Design Reviews give teams a chance to present to and receive feedback from a panel of engineering judges about their robot designs. Held early in the season, they serve as a checkpoint in teams' development processes while fostering presentation skills and encouraging professionalism.

This new event to the PiE competition season occurred in the third week of the season, during UC Berkeley's spring break. In front of a panel consisting of UC Berkeley professors, professional engineers, alumni, and PiE staff, teams made formal presentations of their intended designs and received feedback. Each team had thirty minutes to present their intended design, game strategy, and build prototypes.

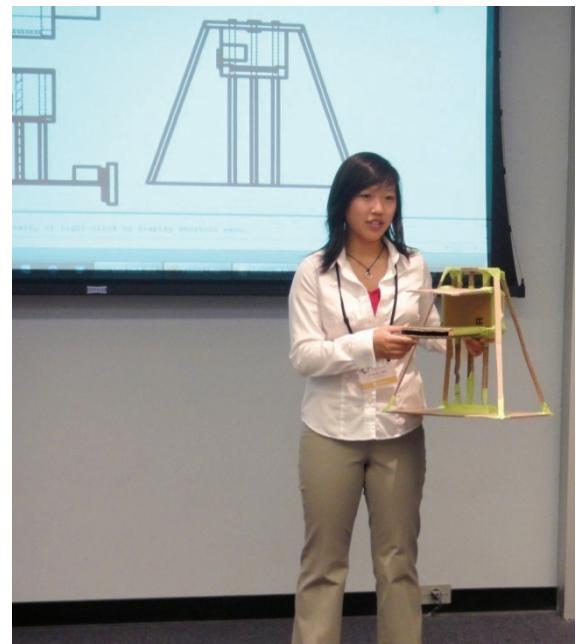
Teams came to Design Reviews with different levels of preparation, some with prototypes and detailed drawings and others with notions and questions. Judges gave feedback and guidance without giving commands, leaving room for teams to grow and work with their mentors. Teams that came better prepared left with a clearer direction, while others realized the importance of planning and prototyping.

The Design Review events suffered from a few organizational issues. In particular, timing was difficult to manage: some teams had to wait for long periods of time and others missed their appointments. Stricter policy on timeliness and presentation length would keep scheduling manageable. As for presentation content, detailed expectation guidelines might make teams' review experience more consistent, effective, and useful. Despite these setbacks, Design Reviews were extremely successful in guiding every team toward the finish line, and also showed which teams needed more help and assistance.



*Top: Team 11 Ralph Bunche students Ennis Smith (left) and Jason McGhee deliver their design review presentation.*

*Bottom: Team 8 Oakland Tech student Jessalyn Siu demonstrates a mechanism prototype.*



## SCRIMMAGE

Scrimmage is held a week before Final Competition as a practice competition for students, mentors, and staff. Teams have an opportunity to test their robots and learn the match queuing process, while the staff have an opportunity to test the field control system.

This year, Scrimmage began on a Sunday morning and ran to late afternoon. Teams arrived on time and immediately got to work using the tools and workspaces provided. Most were still finishing their robot builds, and very few robots eventually made it to the field at all. Despite the early stage of completion most teams were at, Scrimmage was still extremely useful to everyone. Many robots drove for the first time, and every team was able to see the field and make progress.

The Scrimmage event had the busy atmosphere of a large work session. Although this was part of what we wanted to encourage, we had hoped for a more organized and competitive environment. Nevertheless, Scrimmage was incredibly effective and fruitful for everyone, and we saw friendly, cooperative team interactions as a pleasant side effect.



*Team 1 Acalanes debugs their robot at Scrimmage.*

## FINAL COMPETITION

The entire PiE season builds up to the Final Competition, an all-day event that students, mentors, and staff have all been preparing for. After matches to seed teams, an elimination tourney narrows down the field to semifinalists and finally, a Competition Champion. To finish the season, an awards ceremony honors excellent design, engineering spirit, and professionalism.

The 2011 Final Competition was primarily staffed by volunteer Tau Beta Pi officers and members due to the large number of competition staff required. Staff and coordinators were assigned to technical support or supervisory roles. Teams arrived with these staffing preparations in place and made finishing touches to their robots before the first scheduled matches.

Unfortunately, the match schedule was delayed by an hour due to technical issues with field control. Despite the setback, we overcame these problems in the morning, and matches ran smoothly throughout the rest of the day. In the afternoon, each team was seeded into a double-elimination bracket that produced two eventual competition champions.

During the competition, dignitaries such as professors and alumni served as judges. Following the final rounds, the judges convened and made decisions on awards for engineering professionalism, mechanical design and software excellence, and a special Judges' Award. The closing ceremony featured these winners, as well as awards for the competition champions and best mentor.

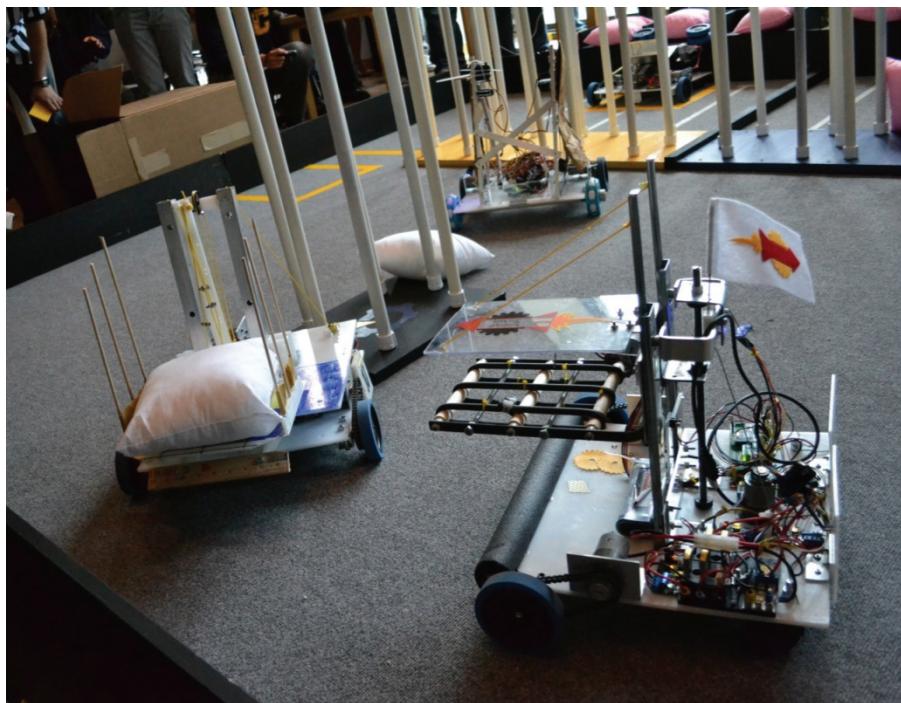


*Team 11 Ralph Bunche adjusts their robot's end effector between matches.*

At Final Competition, all twelve of the teams were able to score a pillow via remote control. Moreover, two teams were able to score pillows autonomously, which is a considerable improvement over last year, when no team attempted autonomous scoring. On the planning side, field control and scheduling are areas of improvement for future competitions.

College of Engineering Dean Sastry enjoyed the competition's final rounds, developing personal relationships with the coordinators of PiE, and delivered a short speech to all the future engineers at the beginning of the awards ceremony. Other professors made appearances throughout the day.

Among the public in attendance at the competition were reporters from the Daily Californian campus newspaper, College of Engineering, and Berkeleyside, a well-known local media outlet. PiE was featured in the June issue of the College of Engineering's Innovations newsletter.



*Top: College of Engineering Dean Shankar Sastry (center) chats with PiE Director Ryan Julian (left) and competition emcee Aaron Alpert (right)*

*Left: Robots compete board to board in a match of Pillow Fight.*

## TESTIMONIALS

"It's really fun, even if you lose and your robot breaks and falls to pieces... just knowing that you can do all of this was just a great experience and feeling."

- Meaghan Riske, Acalanes High School

"I enjoyed...driving around and making the arm work. It was like 'Wow. I made this thing, an actual robot.'"

- Kevin Yang, El Cerrito High School

"I've participated in robotics competitions...but being a mentor requires a completely different skill set. You get to spur innovation and learn with the students... can't wait to see what next year's competition will be."

- Matthew Chang, 1st year  
Electrical Engineering and  
Computer Science

"I learned loads about robot design and... general engineering principles that I wouldn't have otherwise."

- Christian Pedersen, 1st year  
Electrical Engineering and  
Computer Science

"The smiles on my students' faces at the end of the season and their desire to participate next year made my PiE experience fulfilling."

- Albert Lu, 1st year  
Bioengineering



*Top: Referee Wes Hunt (center) watches the competition.*

*Bottom: Team 1 Acalanes was one of the two 2011 Competition Champions.*



# ADMINISTRATION

The coordinator team spent the summer of 2010 building an organizational structure for PiE. The coordinators structured PiE into three committees: Kit Development, responsible for research and development of the robot kit; Mentorship, responsible for mentor and high school student training; and External Relations, responsible for fundraising, inter-society and university relations, and event planning. Each branch is headed by a coordinator who work directly with the Director and Deputy Director of PiE. The Director, Deputy Director, and TBP Liaison work mutually with the UC Berkeley chapter of Tau Beta Pi. The coordinators also set up organization aids such as mailing lists, file shares, and an internal wiki to document best practices.



*The 2011 staff and coordinators of Pioneers of Engineering pose for a photo after a successful Final Competition.*

## KIT DEVELOPMENT

Kit Development works to improve, document, and support the PiE robotics kit. Every year, this common robot platform is given to teams to expedite the build process and guarantee a minimum degree of functionality for all robots. Developing this kit in-house gives us great flexibility in tailoring the kit to the students and competition, and also gives PiE staff a chance to apply themselves to a challenging engineering problem. Commercially-available off-the-shelf components are used whenever possible to lower kit costs and procurement times.

Following last year's final competition, during which the second version of the kit was found to have serious flaws, Kit Development decided to develop a completely new kit. The third version of the kit was designed with a focus on usability and robustness, resulting in a solid but feature-limited kit that can be revised and expanded in future years.

In addition to the standard kit, Kit Development made available a store of other common components, referred to as the "extended kit of parts" or "kit extension." These components were integrated with the standard kit, allowing teams to explore many design avenues. Having this store of parts readily available gave students a chance to see what sorts of components were available, in addition to providing teams with components on demand. To prevent store abuse, an extension budget was assigned to each team.

The kit development subcommittees were organized to allow for parallel development of the kit. Staff members were divided by discipline into mechanical, electrical, and software teams of two to five members and one lead each. Kit components were assigned to teams, and in most instances, were completely developed by a single team. Teams worked at kit development worksessions to reduce communication overhead, though this reduced each team's scheduling flexibility. A better solution might be to create multidisciplinary teams around components instead.

Since the standard kit is used by all teams, it must be extensively tested to guarantee reliability. For this purpose, Kit Development completed a prototype robot platform by the end of the fall semester and fully tested the drivetrain, electronics, and basic software, as well as system integration. Revisions to the initial design were made in the first month of the spring semester, after which the design was frozen for manufacture.

Most of the manufacturing time was spent machining components in the campus machine shop and writing documentation. Even basic components were especially time consuming due to large quantities, though this was eventually alleviated by improved production techniques. Additional work on designing parts and shop process planning can further increase the scalability of the kit. Full material lists and quickstart assembly instructions for all components of the basic kit were written and packaged with the kit, making the kit truly ready to assemble and drive straight out of the box.



*Team 4 El Cerrito student Andy Lau drives the assembled kit.*

## MENTORSHIP

The Mentorship committee was formed to recruit, prepare, and oversee the mentors for each season, as well as offer learning resources to students. Mentorship's most important duty is managing the PiE DeCal, 12-week course critical to mentor development.

This year, the introduction of the DeCal gave the Mentorship committee a lot on their plate. Planning for the DeCal began early in summer 2010 to fill the need for mentor education. The course structure and lessons were developed and rehearsed in the fall and then finalized in the winter before the class was taught.

In the first five weeks of the DeCal, mentors were guided through five fundamental lab lessons that gave many their first glimpse into the world of robotics as they assembled a drivable robot from the PiE kit. Over the course of the competition season, the DeCal and its facilitators continued to provide technical knowledge to mentors via a variety of lessons that included feedback control, end-effector design, and sensor implementation.

Mentorship's hard work and effort paid off towards the end of the season as mentors expressed that they felt better prepared in helping high school teams. Moreover, many mentors developed friendly relationships with their students, and impressed upon their high school teams an enthusiasm for robotics and engineering.

Mentorship was additionally responsible for planning workshops, taught to high school teams, at Kickoff. The success of these modules suggest that more workshops could be developed in future years.



*Team 4 El Cerrito student Andy Lau (right) measures twice as mentor Dennis Wai supervises.*

## EXTERNAL RELATIONS

Certain elements of PiE never rest, particularly External Relations and their efforts in fundraising, university relations, and publicity.

In summer 2010, External Relations made a grant target list and began writing content. The results of these fundraising efforts are detailed in the following section on finances.

The Director and External Relations Coordinator spent a great deal of time building relations with campus administration. This eventually allowed us to establish a fund in the university endowment - the Pioneers in Engineering Fund of the UC Berkeley Foundation - and secured us a large robot-building space from the engineering administration in an extremely space-constrained campus.

External Relations also spearheaded publicity and communication efforts such as student recruitment, team communications, and external publicity. These myriad and assorted tasks yielded significant results, not the least of which were more staff members than ever before, as well as a media presence at the Final Competition.

*Head Judge Dr. George Anwar (left) discusses the field with Dr. Brian Harvey (center) and Professor Alice Agogino (right) at Final Competition.*



## FINANCES AND SPONSORSHIP

As a non-profit and student-run project, it is necessary to raise the funds for the PiE Competition through sponsorship, donations, and other sources. A major goal for fundraising for the 2010-2011 PiE season was to find a long-term source of sponsorship through corporate donations. We carried this out by carefully planning the budget for the year before pursuing corporate grants via applications and personal connections.

We estimated the total budget at around \$15,000. This was mostly separated into the variable costs for the development and materials for the kit, as well as a large fixed cost that included expenses like competition day support materials, field construction materials, and tools.

During the fall semester, External Relations made a major effort to write grant applications to philanthropy arms of major Bay Area engineering corporations. We sent approximately 15 applications to these companies, including Google, Lockheed Martin, KLA-Tencor, Xerox, and more. While we drafted and revised the grant applications with significant detail and care, we received very few responses. We attribute this to several factors, including the nature of PiE as a new project, the scattered focus of Bay Area corporate philanthropy, and the lack of personal interaction and communication with those reviewing the grants.

Personal interactions with industry pursued in parallel with the grant-writing efforts yielded significantly better results. Through our communication with recruiters and other corporate contacts, we raised \$11,400 from companies including Lockheed Martin, Google, and Qualcomm.

Our success in pursuing personal corporate contacts has convinced us that this is a much better avenue toward the long-term success of PiE as a non-profit project. While it will likely be necessary to pursue further grants, we will focus future efforts on personal connections and grants that align very well with PiE's purpose and motivation.

## 2011 BUDGET AND FUNDING

Expenses		Funds Raised	
Basic robot kits	\$7,250	2010 surplus	\$2,165
Extra parts and tools	\$3,270	UC Berkeley College of Engineering	\$4,000
Kit research and development	\$1,550	Lockheed Martin	\$3,000
Event administration	\$1,500	Google	\$2,000
Mentor training materials and parts	\$450	Qualcomm	\$1,200
Recruitment and fundraising	\$170	Team entrance fees	\$1,200
		Private donations	\$1,200
<b>Total</b>	<b>\$14,190</b>	<b>Total</b>	<b>\$14,765</b>

## PROJECT TIMELINE

TASK	TARGET TIME SPAN
Leadership formation, planning, and fundraising	May - August 2010
Staff recruitment and training	August - September 2010
Robot kit development and revision	September - December 2010
DeCal curriculum development and revision	September - December 2010
Detailed season and event planning	November 2010 - February 2011
High school recruiting	December 2010 - February 2011
College student mentors' DeCal	January - May 2011
Season Kickoff	Early March 2011
Design Reviews	Late March 2011
Scrimmage	Mid-April 2011
Final Competition	Late April 2011
Close-out and Postmortem (season review)	Early May 2011



*Team 12 Bishop O'Dowd student Dean Tarpey contemplates his team's robot.*

# SEASON OUTCOMES

PiE staff were very happy with the outcomes of the 2011 season, which far exceeded expectations from previous years. This started at Kickoff, when we connected 12 teams with several mentors each, a larger audience than ever before. Design Reviews and Scrimmage were instrumental in ensuring team progress and contributed to students' experience. Most significantly, the competition was a great success. Every single team built a robot that successfully scored in the competition, demonstrating the incredible efforts and achievements of the students and mentors, as well as the quality of the kit.

In terms of staff and organizational administration, 2011 saw the advent of a new staff structure, more undergraduate involvement than ever before, and fruitful efforts from each committee. Kit Development designed the cheapest, most flexible, and most robust platform in PiE's short history. Mentorship created the mentor DeCal, which brought in a diverse group of college students to work with the teams. External gained experience in finances and grant-writing, as well as creating key contacts for future years.

The success of the 2011 season has laid a promising groundwork for next year. PiE increased its presence on campus, in both undergraduate and administrative circles. The strength of PiE's ties to Cal and the College of Engineering ensure its continued development and future success. Improved relationships with teachers also bode well for PiE. All the teams and teachers we talked to after the competition expressed enthusiasm in participating again next year. Publicity from the competition has already brought interest from other teachers.

One particular story from PiE 2011 gives us inspiration and direction for future improvement. This year, we worked with a student named Ennis. Originally unwilling to join his school's team, he was convinced by his teacher to join. At early work sessions Ennis whiled away time uninterested, but as the season progressed, he became increasingly curious and involved. By Final Competition he was actively leading his team, even coming alone to work on the robot from early in the morning until midnight at a late work session.

The experience of PiE has changed Ennis's perspective on school, motivating him to pursue a college education. He is currently taking summer classes to prepare for his senior year in high school, and is looking forward to participating in PiE next year.



# FUTURE DIRECTIONS

The successes and shortcomings of the 2011 season will inform improvements and goals heading into 2012 and beyond. Our goals for 2012 are to make incremental improvements upon our current kit; offer more learning resources to teams; pursue new directions in our fundraising efforts; and expand to a wider, more diverse audience of students, mentors, and staff.

Compared with the kit from 2010, the 2011 kit was an overwhelming success. The relative usability and reliability, as well as many options for expansion and divergent design, were particularly strong features. The kit played no small part in teams' universal success in developing a working robot by competition. Nevertheless, improvements always remain to be made. Issues with robustness of electrical and software systems plagued the build season and cost hundreds of dollars. The extensibility, machinability, and tidiness of the kit's mechanical components are other areas for progress. Documentation of the kit and its components must also be improved, for the sake of end users as well as the next generation of developers. The Kit Development committee has a busy year in store.



*Team 8 Oakland Tech, the winner of the 2011 Software and Sensors award, poses for a picture with mentors Jared Porter (back row, second from left) and Peter Nakamoto (middle row, far right)*

This year's new DeCal class was incredibly useful in bringing Cal student mentors to PiE. In future years, lesson and demonstration development will be areas of constant iterative improvement as kit technologies and focuses change. Mentor recruitment and retention are another key goal to ensure the strength of future team experiences. Workshop and other resource development have also been identified as priorities for next year.

With experience from past years' measurably successful yet limited fundraising efforts, future work will be focused in promising directions. We plan to engage with more campus and student life entities, companies and local businesses, and philanthropic donors. Even more polished publicity and a strong External Relations team will gather the contacts and resources necessary to ensure financial stability in the short and long term.

Along with general improvement, expansion is a critical part of PiE's plans for next year. We hope to recruit more staff, more mentors, and more teams. Efforts to recruit staff and mentors will be driven by past experience and mainly focus on students in the College of Engineering, which still has great untapped potential. Team recruitment is another matter, as we plan to mount a targeted effort to work with schools and students in particularly low-income, underprivileged areas. This year's positive outcomes from active outreach have shown that it is exceptionally worth pursuing.

<b>2011 Budget</b>		<b>2012 Budget (Projected)</b>	
Basic robot kits	\$7,250	Kit extension	\$13,300
Extra parts and tools	\$3,270	Robot kits	\$11,400
Kit research and development	\$1,550	Kit development	\$3,100
Event administration	\$1,500	Events	\$2,800
Mentor training materials and parts	\$450	Mentorship	\$2,200
Recruitment and fundraising	\$170	External relations	\$1,000
		Game design	\$600
		Administration	\$200
<b>Total</b>	<b>\$14,190</b>	<b>Total</b>	<b>\$34,600</b>

# CONCLUSION

The goal of PiE to create an affordable science and technology experience was handily realized by the 2011 competition. As outlined above, the successful participation and completion of the competition by 12 high school teams totaling about 100 students spread interest in engineering-related topics across the San Francisco Bay Area. This year's kit, game, mentors, and staff were more mature than ever before, and all positively contributed to students' experience.

Another area of great success this year comes from efforts to make the competition financially and otherwise sustainable. While no long-term source of funding was obtained, meaningful corporate relationships were formed. We expect that these will develop into long-term, mutually beneficial partnerships that will allow PiE to receive funding for years into the future. PiE also made significant progress in integrating the competition into the UC Berkeley campus. The College of Engineering continues to work closely with PiE and TBP to extend its own outreach efforts. This includes efforts to publicize the program to a wider audience of students to participate as mentors and staff.

In sum, our main goals for next year are to further improve staff recruitment and retention and increase the diversity and quantity of teams while maintaining the high standards of the 2011 season. We hope to further our outreach efforts to engineering companies and publicize PiE to as large an audience as possible. With continued effort and innovation, Pioneers in Engineering will thrive as an organization and deliver progressively amazing experiences in 2012 and beyond.



*Student Kyle Pierce (left) from Team 8 Oakland Tech presents his team's design to Professor Alice Agogino after the Final Competition.*