Joshua Davis

La Vida Robot

How four underdogs from the mean streets of Phoenix took on the best from MIT in the national underwater bot championship

The winter rain makes a mess of West Phoenix. It turns dirt yards into mud and forms reefs of garbage in the streets. Junk food wrappers, diapers, and porn in Spanish are swept into the gutters. On West Roosevelt Avenue, security guards, two squad cars, and a handful of cops watch teenagers file into the local high school. A sign reads: Carl Hayden Community High School: The Pride's Inside.

There certainly isn't a lot of pride on the outside. The school buildings are mostly drab, late '50s–era boxes. The front lawn is nothing but brown scrub and patches of dirt. The class photos beside the principal's office tell the story of the past four decades. In 1965, the students were nearly all white, wearing blazers, ties, and long skirts. Now the school is 92 percent Hispanic. Drooping, baggy jeans and XXXL hoodies are the norm.

The school PA system crackles, and an upbeat female voice fills the bustling linoleum-lined hallways. "Anger management class will begin in five minutes," says the voice

from the administration building. "All referrals must report immediately."

Across campus, in a second-floor windowless room, four students huddle around an odd, three-foot-tall frame constructed of PVC pipe. They have equipped it with propellers, cameras, lights, a laser, depth detectors, pumps, an underwater microphone, and an articulated pincer. At the top sits a black, waterproof briefcase containing a nest of hacked processors, minuscule fans, and LEDs. It's a cheap but astoundingly functional underwater robot capable of recording sonar pings and retrieving objects 15 feet below the surface. The four teenagers who built it are all undocumented Mexican immigrants who came to this country through tunnels or hidden in the backseats of cars. They live in sheds and rooms without electricity. But over three days last summer, these kids from the desert proved they were among the smartest young underwater engineers in the country.

It was the end of June. Lorenzo Santillan, 16, sat in the front seat of the school van and looked out at the migrant farmworkers in the fields along Interstate 10. Lorenzo's face still had its baby fat, but he'd recently sprouted a mustache and had taken to wearing a fistful of gold rings, a gold chain, and a gold medallion of the Virgin Mary pierced through the upper part of his left ear. The bling wasn't fooling anyone. His mother had been fired from her job as a hotel maid, and his father had trouble paying the rent as a gardener. They were on the verge of eviction for nonpayment.

He could see himself having to quit school to work in those fields.

"What's a PWM cable?" The sharp question from the van's driver, Allan Cameron, snapped Lorenzo out of his reverie. Cameron is the computer science teacher who

cosponsors Carl Hayden's robotics program. At 59, he has a neatly trimmed white beard, unkempt brown hair, and more energy than most men half his age. Together with his fellow science teacher Fredi Lajvardi, Cameron had put up flyers around the school a few months earlier, offering to sponsor anyone interested in competing in the third annual Marine Advanced Technology Remotely Operated Vehicle Competition. Lorenzo was one of the first to show up to the after-school meeting last spring.

Cameron hadn't expected many students to be interested, particularly not a kid like Lorenzo, who was failing most of his classes and perpetually looked like he was about to fall asleep. But Lorenzo didn't have much else to do after school. He didn't want to walk around the streets. He had tried that—he'd been a member of WBP 8th Street, a West Side gang. When his friends started to get arrested for theft, he dropped out. He didn't want to go to jail.

That's why he decided to come to Cameron's meeting.

"PWM," Lorenzo replied automatically from the van's passenger seat. "Pulse width modulation. Esto controls analog circuits with digital output."

Over the past four months, Lorenzo had flourished, learning a new set of acronyms and raising his math grade from an F to an A. He had grown up rebuilding car engines with his brother and cousin. Now he was ready to build something of his own. The team had found its mechanics man.

Ever since his younger sister demanded her own room four years ago, Cristian Arcega has been living in a 60-square-foot plywood shed attached to the side of his parents' trailer. He likes it there. It's his own space.

He's free to contemplate the acceleration of a raindrop as it leaves the clouds above him. He can hear it hit the roof

and slide toward the puddles on the street outside. He imagines that the puddles are oceans and that the underwater robot he was building at school can explore them.

Cameron and Ledge, as the students called Lajvardi, formed the robotics group for kids like Cristian. He was probably the smartest 16-year-old in West Phoenix—without even trying, he had one of the highest GPAs in the school district. His brains and diminutive stature (five feet four, 135 pounds) kept him apart at Carl Hayden. That and the fact that students socialized based on Mexican geography: In the cafeteria, there were Guanajuato tables and Sonoran tables. Cristian was from Mexicali, but he'd left Mexico in the back of a station wagon when he was 6. He thought of himself as part American, part Mexican, and he didn't know where to sit.

So he ate lunch in the storage room the teachers had comandeered for the underwater remotely operated vehicle (ROV) club. Cristian devoted himself to solving thrust vector and power supply issues. The robot competition required students to build a bot that could survey a sunken mock-up of a submarine (it was sponsored in part by the Office of Naval Research and NASA)—not easy stuff. The teachers had entered the club in the expert-level Explorer class instead of the beginner Ranger class. They figured their students would lose anyway, and there was more honor in losing to the college kids in the Explorer division than to the high schoolers in Ranger. Their real goal was to show the students that there were opportunities outside West Phoenix. The teachers wanted to give their kids hope.

Just getting them to the Santa Barbara contest in June with a robot would be an accomplishment, Cameron thought. He and Ledge had to gather a group of students who, in four months, could raise money, build a robot, and

learn how to pilot it. They had no idea they were about to assemble the perfect team.

"We should use glass syntactic flotation foam," Cristian said excitedly at that first meeting. "It's got a really high compressive strength."

Cameron and Ledge looked at each other. Now they had their genius.

Oscar Vazquez was a born leader. A senior, he'd been in ROTC since ninth grade and was planning on a career in the military. But when he called to schedule a recruitment meeting at the end of his junior year, the officer in charge told him he was ineligible for military service. Because he was an undocumented alien—his parents had brought him to the United States from Mexico when he was 12—he couldn't join, wouldn't get any scholarships, and had to start figuring out what else to do with his life. Oscar felt aimless until he heard about the robot club from Ledge, who was teaching his senior biology seminar. Maybe, he thought, engineering could offer him a future.

ROTC had trained Oscar well: He knew how to motivate people. He made sure that everyone was in the room and focused when he phoned Frank Szwankowski, who sells industrial and scientific thermometers at Omega Engineering in Stamford, Connecticut. Szwankowski knows as much about thermometer applications as anyone in the United States. All day long, he talks to military contractors, industrial engineers, and environmental consultants. So he was momentarily confused when he heard Oscar's high-pitched Mexican accent on the other end of the line. The 17-year-old kid from the desert wanted advice on how to build a military-grade underwater ROV.

This was the second call Szwankowski had received

from amateur roboticists in less than a month. A few weeks earlier, students from MIT's oceanic engineering department had called and said they were entering the national underwater ROV championships. Oscar said that his team, too, was competing and needed to learn as much as it could from the experts. Szwankowski was impressed. The MIT kids had simply asked him what they wanted and hung up.

Oscar spent 45 minutes on the phone digging deeper and deeper into thermometer physics.

Oscar began by explaining that his high school team was taking on college students from around the United States. He introduced his teammates: Cristian, the brainiac; Lorenzo, the *vato loco* who had a surprising aptitude for mechanics; and 18-year-old Luis Aranda, the fourth member of the crew. At five feet ten and 250 pounds, Luis looks like Chief from *One Flew over the Cuckoo's Nest.* He was the tether man, responsible for the pickup and release of what would be a 100-pound robot.

Szwankowski was impressed by Oscar. He launched into an in-depth explanation of the technology, offering details as if he were letting them in on a little secret. "What you really want," he confided, "is a thermocouple with a cold junction compensator." He went over the specifications of the device and then paused. "You know," he said, "I think you can beat those guys from MIT. Because none of them know what I know about thermometers."

"You hear that?" Oscar said triumphantly when they hung up. He looked at each team member pointedly. "We got people believing in us, so now we got to believe in ourselves."

Oscar helped persuade a handful of local businesses to donate money to the team. They raised a total of about $800. Now it was up to Cristian and Lorenzo to figure out what to

do with the newfound resources. They began by sending Luis to Home Depot to buy PVC pipe. Despite the donations, they were still on a tight budget. Cristian would have to keep dreaming about glass syntactic flotation foam; PVC pipe was the best they could afford.

But PVC had benefits. The air inside the pipe would create buoyancy as well as provide a waterproof housing for wiring. Cristian calculated the volume of air inside the pipes and realized immediately that they'd need ballast.

He proposed housing the battery system on board, in a heavy waterproof case.

It was a bold idea. If they didn't have to run a power line down to the bot, their tether could be much thinner, making the bot more mobile. Since the competition required that their bot run through a series of seven exploration tasks—from taking depth measurements to locating and retrieving acoustic pingers—mobility was key. Most of the other teams wouldn't even consider putting their power supplies in the water. A leak could take the whole system down. But if they couldn't figure out how to waterproof their case, Cristian argued, then they shouldn't be in an underwater contest.

While other teams machined and welded metal frames, the guys broke out the rubber glue and began assembling the PVC pipe. They did the whole thing in one night, got high on the pungent fumes, and dubbed their new creation Stinky. Lorenzo painted it garish shades of blue, red, and yellow to designate the functionality of specific pipes. Every inch of PVC had a clear purpose. It was the type of machine only an engineer would describe as beautiful.

Carl Hayden Community High School doesn't have a swimming pool, so one weekend in May, after about six weeks of work in the classroom, the team took Stinky to a scuba training pool in downtown Phoenix for its baptism.

Luis hefted the machine up and gently placed it in the

water. They powered it up. Cristian had hacked together off-the-shelf joysticks, a motherboard, motors, and an array of onboard finger-sized video cameras, which now sent flickering images to black-and-white monitors on a folding picnic table.

Using five small electric trolling motors, the robot could spin and tilt in any direction. To move smoothly, two drivers had to coordinate their commands. The first thing they did was smash the robot into a wall.

"This is good, this is good," Oscar kept repeating, buying himself a few seconds to come up with a positive spin. "Did you see how hard it hit the wall? This thing's got power. Once we figure out how to drive it, we'll be the fastest team there."

By early June, as the contest neared, the team had the hang of it. Stinky now buzzed through the water, dodging all obstacles. The drivers, Cristian and Oscar, could make the bot hover, spin in place, and angle up or down. They could send enough power to Stinky's small engines to pull Luis around the pool. They felt like they had a good shot at not placing last.

The team arrived at the Olympic-size UC Santa Barbara pool on a sunny Thursday afternoon. The pool was concealed under a black tarp—the contest organizers didn't want the students to get a peek at the layout of the mission. College students from cities across the country—Long Beach, California; Miami, Florida; Galveston, Texas; New Haven, Connecticut; and half a dozen others—milled around the water's edge. The Carl Hayden teammates tried to hide their nervousness, but they were intimidated. Lorenzo had never seen so many white people in one place. He was also new to the ocean.

He had seen it for the first time several months earlier

on a school trip to San Diego. It still unnerved him to see so much water. He said it was "incredifying"—incredible and terrifying at the same time.

Even though Lorenzo had never heard of MIT, the team from Cambridge scared him, too. There were 12 of them—6 ocean-engineering students, 4 mechanical engineers, and 2 computer science majors. Their robot was small, densely packed, and had a large ExxonMobil sticker emblazoned on the side. The largest corporation in the United States had kicked in $5,000 for the privilege of sponsoring them. Other donations brought the MIT team's total budget to $11,000.

As Luis hoisted Stinky to the edge of the practice side of the pool, Cristian heard repressed snickering. It didn't give him a good feeling. He was proud of his robot, but he could see that it looked like a Geo Metro compared with the Lexuses and BMWs around the pool. He had thought that Lorenzo's paint job was nice. Now it just looked clownish.

Things got worse when Luis lowered Stinky into the water. They noticed that the controls worked only intermittently. When they brought Stinky back onto the pool deck, there were a few drops of water in the waterproof briefcase that housed the control system. The case must have warped on the trip from Arizona in the back of Ledge's truck. If the water had touched any of the controls, the system would have shorted out and simply stopped working.

Cristian knew that they were faced with two serious problems: bad wiring and a leak.

Oscar sketched out the situation. They'd have to resolder every wire going into the main controller in the next 12 hours. And they would either have to fix the leak or find something absorbent to keep moisture away from the onboard circuitry.

An image from television flashed through Lorenzo's mind. "Absorbent?" he asked. "Like a tampon?"

The Ralph's grocery store near the UCSB campus is done up to look like a hacienda, complete with a red tile roof, glaringly white walls, and freshly planted palms. The guys dropped Lorenzo off in front. It was his bright idea, after all. He wandered past the organic produce section, trying to build up his courage. He passed an elderly lady examining eggplant—he was too embarrassed to ask her. Next, he saw a young woman in jeans shopping for shampoo.

"Excuse me, madam," he began. He wasn't used to approaching women, let alone well-dressed white women. He saw apprehension flash across her face.

Maybe she thought he was trying to sell magazines or candy bars, but he steeled himself. He explained that he was building a robot for an underwater contest, and it was leaking. He wanted to soak up the water with tampons but didn't know which ones to buy. "Could you help me buy the most best tampons?"

The woman broke into a big smile and led him to feminine hygiene. She handed him a box of O.B. ultraabsorbency. "These don't have an applicator, so they'll be easier to fit inside your robot," she said. He stared at the ground, mumbled his thanks, and headed quickly for the checkout.

"I hope you win," she called out, laughing.

Someone had to be well rested for the contest, so Cristian and Luis slept that night. Oscar and Lorenzo stayed up resoldering the entire control system. It was nerve-racking work. The wires were slightly thicker than a human hair, and there were 50 of them. If the soldering iron got too close to a wire, it would melt and there'd be no time to rip the

PVC and cable housing apart to fix it. One broken wire would destroy the whole system, forcing them to withdraw from the contest.

By two in the morning, Oscar's eyesight was blurring, but he kept at it.

Lorenzo held the wires in place while Oscar lowered the soldering gun. He dropped one last dab of alloy on the connection and sat back. Lorenzo flipped the power switch. Everything appeared to work again.

On the day of the contest, the organizers purposely made it difficult to see what was happening under the water. A set of high-powered fans blew across the surface of the pool, obscuring the view below and forcing teams to navigate by instrumentation alone. The side effect was that no one had a good sense of how the other teams were doing.

When Luis lowered Stinky into the water for their run, Lorenzo prayed to the Virgin Mary. He prayed that the tampons would work but then wondered if the Virgin got her period and whether it was appropriate for him to be praying to her about tampons. He tried to think of a different saint to pray to but couldn't come up with an appropriate one. The whir of Stinky's propellers brought him back to the task at hand, extracting a water sample from a submerged container.

The task was to withdraw 500 milliliters of fluid from the container 12 feet below the surface. Its only opening was a small, half-inch pipe fitted with a one-way valve. Though the Carl Hayden team didn't know it, MIT had designed an innovative system of bladders and pumps to carry out this task.

MIT's robot was supposed to land on the container, create a seal, and pump out the fluid. On three test runs in Boston, the system worked fast and flawlessly.

MIT's ROV motored smoothly down and quickly located the five-gallon drum inside the plastic submarine mock-up at the bottom of the pool. But as the robot approached the container, its protruding mechanical arm hit a piece of the submarine frame, blocking it from going farther. They tried a different angle but still couldn't reach the drum. The bot wasn't small enough to slip past the gap in the frame, making their pump system useless. There was nothing they could do—they had to move on to the next assignment.

When Stinky entered the water, it careened wildly as it dived toward the bottom. Luis stood at the pool's edge, paying out the tether cable. From the control tent, Cristian, Oscar, and Lorenzo monitored Stinky's descent on their video screens.

"Vamonos, Cristian, this is it!" Oscar said, pushing his control too far forward. They were nervous and overcompensated for each other's joystick movements, causing Stinky to veer off course. When they reached the submarine, they saw the drum and tried to steady the robot. Stinky had a bent copper proboscis, a bilge pump, and a dime-store balloon. They had to fit their long, quarter-inch-wide sampling tube into a half-inch pipe and then fill the balloon for exactly 20 seconds to get 500 milliliters. They had practiced dozen of times at the scuba pool in Phoenix, and it had taken them, on average, 10 minutes to stab the proboscis into the narrow tube.

Now they had 30 minutes total to complete all seven tasks on the checklist.

It was up to Oscar and Cristian. They readjusted their grip on the joysticks and leaned into the monitors. Stinky hovered in front of the submarine framing that had frustrated the MIT team. Because Stinky's copper pipe was 18 inches long, it was able to reach the drum. The control tent

was silent. Now that they were focused on the mission, both pilots relaxed and made almost imperceptibly small movements with their joysticks. Oscar tapped the control forward while Cristian gave a short backward blast on the vertical propellers. As Stinky floated forward a half inch, its rear raised up, and the sampling pipe sank perfectly into the drum.

"Dios mio," Oscar whispered, not fully believing what he saw.

He looked at Lorenzo, who had already activated the pump and was counting out 20 seconds in a decidedly unscientific way.

"Uno, dos, tres, quatro . . ."

Oscar backed Stinky out of the sub. They spun the robot around, piloted it back to Luis at the edge of the pool, and looked at the judges, who stood in the control tent behind them.

"Can we make a little noise?" Cristian asked Pat Barrow, a NASA lab operations manager supervising the contest.

"Go on ahead," he replied.

Cristian started yelling, and all three ran out to hug Luis, who held the now-filled blue balloon. Luis stood there with a silly grin on his face while his friends danced around him.

It was a short celebration. They still had four more tasks. Luis attached Szwankowski's thermometer and quickly lowered the ROV back into the water.

Tom Swean is the gruff 58-year-old head of the Navy's Ocean Engineering and Marine Systems program. He develops million-dollar autonomous underwater robots for the SEALs at the Office of Naval Research. He's not used to dealing with Mexican American teenagers sporting gold

chains; fake diamond rings; and patchy, adolescent mustaches.

The Carl Hayden team stood nervously in front of him. He stared sullenly at them. This was the engineering review—professionals in underwater engineering evaluated all the ROVs, scored each team's technical documentation, and grilled students about their designs. The results counted for more than half of the total possible points in the contest.

"How'd you make the laser range finder work?" Swean growled. MIT had admitted earlier that a laser would have been the most accurate way to measure distance underwater, but they'd concluded that it would have been difficult to implement.

"We used a helium neon laser, captured its phase shift with a photo sensor, and manually corrected by 30 percent to account for the index of refraction," Cristian answered rapidly, keyed up on adrenaline. Cameron had peppered them with questions on the drive to Santa Barbara, and Cristian was ready.

Swean raised a bushy, graying eyebrow. He asked about motor speed, and Lorenzo sketched out their combination of controllers and spike relays.

Oscar answered the question about signal interference in the tether by describing how they'd experimented with a 15-meter cable before jumping up to one that was 33 meters.

"You're very comfortable with the metric system," Swean observed.

"I grew up in Mexico, sir," Oscar said.

Swean nodded. He eyed their rudimentary flip chart.

"Why don't you have a PowerPoint display?" he asked.

"PowerPoint is a distraction," Cristian replied. "People use it when they don't know what to say."

"And you know what to say?"

"Yes, sir."

In the lobby outside the review room, Cameron and Ledge waited anxiously for the kids. They expected them to come out shaken, but all four were smiling—convinced that they had answered Swean's questions perfectly.

Cameron glanced nervously at Ledge. The kids were too confident. They couldn't have done that well.

Still, both teachers were in a good mood. They had learned that the team placed third out of 11 in the seven underwater exercises. Only MIT and Cape Fear Community College from North Carolina had done better. The overall winner would be determined by combining those results with the engineering interview and a review of each group's technical manual. Even if they did poorly on the interview, they were now positive that they hadn't placed last.

"Congratulations, guys," Cameron said. "You officially don't suck."

"Can we go to Hooters if we win?" Lorenzo asked.

"Sure," Ledge said with a dismissive laugh. "And Dr. Cameron and I will retire, too."

The awards ceremony took place over dinner, and the Carl Hayden team was glad for that. They hadn't eaten well over the past two days, and even flavorless iceberg lettuce looked good to them. Their nerves had calmed.

After the engineering interview, they decided that they had probably placed somewhere in the middle of the pack, maybe fourth or fifth overall.

Privately, each of them was hoping for third.

The first award was a surprise: a judge's special prize that wasn't listed in the program. Bryce Merrill, the bearded, middle-aged recruiting manager for Oceaneering International, an industrial ROV design firm, was the announcer. He explained that the judges created this spon-

taneously to honor special achievement. He stood behind a podium on the temporary stage and glanced down at his notes. The contestants sat crowded around a dozen tables. Carl Hayden High School, he said, was that special team.

The guys trotted up to the stage, forcing smiles. It seemed obvious that this was a condescending pat on the back, as if to say, "A for effort!"

They didn't want to be "special"—they wanted third. It signaled to them that they'd missed it.

They returned to their seats, and Cameron and Ledge shook their hands.

"Good job, guys," Ledge said, trying to sound pleased. "You did well. They probably gave you that for the tampon."

After a few small prizes were handed out (Terrific Tether Management, Perfect Pick-up Tool), Merrill moved on to the final awards: Design Elegance, Technical Report, and Overall Winner. The MIT students shifted in their seats and stretched their legs. While they had been forced to skip the fluid sampling, they had completed more underwater tasks overall than Carl Hayden or Cape Fear. The Cape Fear team sat across the room, fidgeted with their napkins, and tried not to look nervous. The students from Monterey Peninsula College looked straight ahead. They placed fourth behind Carl Hayden in the underwater trials. They were the most likely third-place finishers. The guys from Phoenix glanced back at the buffet table and wondered if they could get more cake before the ceremony ended.

Then Merrill leaned into the microphone and said that the ROV named Stinky had captured the design award.

"What did he just say?" Lorenzo asked.

"Oh my God!" Ledge shouted. "Stand up!"

Before they could sit down again, Merrill told them that they had won the technical writing award.

"Us illiterate people from the desert?" Lorenzo thought. He looked at Cristian, who had been responsible for a large part of the writing.

Cristian was beaming. To his analytical mind, there was no possibility that his team—a bunch of ESL students—could produce a better written report than kids from one of the country's top engineering schools.

They had just won two of the most important awards. All that was left was the grand prize. Cristian quickly calculated the probability of winning but couldn't believe what he was coming up with. Ledge leaned across the table and grabbed Lorenzo's shirt. "Lorenzo, if what I think is about to happen does happen, I do not, under any circumstances, want to hear you say the word 'Hooters' onstage."

"And the overall winner for the Marine Technology ROV championship," Merrill continued, looking up at the crowd, "goes to Carl Hayden High School of Phoenix, Arizona!"

Lorenzo threw his arms into the air, looked at Ledge, and silently mouthed the word "Hooters."

Cameron and Ledge haven't taken Lorenzo to Hooters, nor have they retired.

They hope to see all four kids go to college before they quit teaching, which means they're likely to keep working for a long time. Since the teenagers are undocumented, they don't qualify for federal loans. And though they've lived in Arizona for an average of 11 years, they would still have to pay out-of-state tuition, which can be as much as three times the in-state cost. They can't afford it.

And they're not alone. Approximately 60,000 undocumented students graduate from U.S. high schools every year. One promising solution, according to Cameron and other advocates for immigrant kids, is the Dream Act, fed-

eral legislation that would give in-state tuition and temporary resident status to undocumented students who graduate from a U.S. high school after being enrolled in the States for five years or more. The bill, which was introduced in 2003 and is slated to be resubmitted this spring, aims to give undocumented students a reason to stay in school. If they do, the act promises financial assistance for college. In turn, immigrants would pay taxes and be able to contribute their talents to the United States.

Some immigration activists don't see it that way. Ira Mehlman, the Los Angeles–based media director for the Federation for American Immigration Reform, successfully lobbied against the legislation last year. He says it will put citizens and legal immigrants in direct competition for the limited number of seats at state colleges. "What will you say to an American kid who does not get into a state university and whose family cannot afford a private college because that seat and that subsidy have been given to someone who is in the country illegally?" he asks.

Oscar wipes the white gypsum dust from his face. It's a hot Tuesday afternoon in Phoenix, and he's putting up Sheetrock. He graduated from Carl Hayden last spring, and this is the best work he can find. He enjoys walking into the half-built homes and analyzing the engineering. He thinks it'll keep him sharp until he can save up enough money to study engineering at Arizona State University. It will cost him approximately $50,000 as an out-of-state student. That's a lot of Sheetrocking.

Luis also graduated and is filing papers in a Phoenix Social Security Services office. Cristian and Lorenzo are now juniors. Their families can barely support themselves, let alone raise the money to send their kids to college. Last summer, Cristian's hopes flagged even further when his

family was forced to spend $3,000 to replace the decrepit air-conditioning unit in their aluminum trailer. Without AC, the trailer turns into a double-wide oven in the desert heat. His family was that much further from being able to save money to send their child to college.

When Oscar gets home from work that night, he watches the gypsum dust swirl down the sink drain when he washes his hands. He wonders what formulas define a vortex. On the other side of the neighborhood, Cristian lies on his bed and tries to picture the moisture in the clouds above. Rain isn't predicted anytime soon.