THE VORTEX

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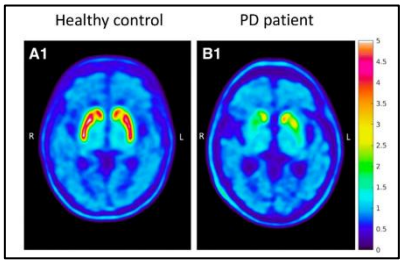

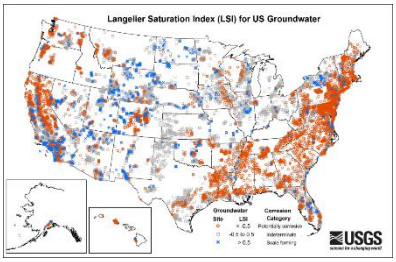

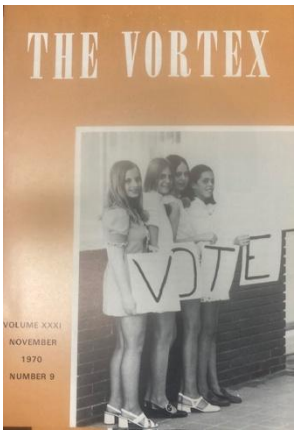

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Middle Right: PET Scan for L-DOPA - https://en.wikipedia.org/wiki/Parkinson%27s_disease
Lower Left: The Vortex Cover from November 1970 – Nicki Davis
Lower center: Zeynep Araci, 2025 Lloyd Ryland Outstanding Teacher Awardee – Taken by Norm Wu
Lower Right: Dr. Patricia Theodosopoulos, winner of our Olympiad Teacher Scholarship – Provided by Eileen Nottoli

This month there is a student voice assignment included as a try out for getting more content.

Cal ACS Chair's Message

The Vortex takes a break in July and August, but there's still plenty of activity in the California Section, and the need for advocacy on behalf of funding for scientific research is more urgent than ever. Science has a critical role to play in government policy, and Chemical and Engineering News (May 28, 2025) is warning of political interference in this role:

President Donald J. Trump's executive order "Restoring Gold Standard Science" is drawing strong criticism from scientists who say the order gives the administration a way to discount scientific evidence it doesn't like or agree with.

Our role as scientists is to provide the best scientific advice based on current knowledge, and to provide the clearest possible explanation of the research process and the level of certainty for the results. The ACS Committee on Public Affairs and Public Relations develops official ACS policy positions on many current issues, an important resource for member advocacy. The message is, stay engaged, don't be silent.

Here in the California Section, we gathered at our annual awards luncheon to honor long-time ACS members, an outstanding high school chemistry teacher, and one of our outstanding volunteer leaders. Our outreach volunteers returned to Lincoln Elementary School in Richmond for STEAM night, and the WCC hosted a Zoom presentation, "From the Laboratory to the Marketplace: The Development of a New Drug' by Natalie McClure of the Silicon Valley Section.

Looking ahead, we hope to see many of you at our third annual Juneteenth/Pride picnic on June 29th at the Roberts Recreational Area in Oakland. I plan to make Toni Morrison's carrot cake. I also encourage you to support the Cal ACS AIDS Walk SF team, and to join us in person if you can make it on July 20th. These events are not only fun, they are great networking opportunities.

Our outreach program continues this month with four Exploration Stations events at libraries in East Contra Costa County – please contact me or Charlie Gluchowski if you want to help out with hands-on science on any of these four dates: June 6th, June 11th, June 18th, or June 25th.

Your executive committee is already preparing to attend the ACS Fall National Meeting in Washington, DC, in the third week of August. Your councilors and other ACS committee members will be hard at work on your behalf (really!) and now would be a great time to contact any of us with your concerns about the Section, your professional situation, or ACS policy, services, and benefits.

Finally, abstract submission for the 2025 Western Regional Meeting is open, and registration is coming very soon. We hope that you and your colleagues plan to join us in San Jose, October 25th – 28th, and right now we are counting on you to help us spread the word! With 34 exciting symposia, a full day of workshops and presentations for undergraduates, and several evening events planned, this is your chance to hear the latest developments in science and technology from across the Bay area and beyond. Be sure to check out the conference highlights, and watch the Cal ACS calendar for other upcoming events.

Alex Madonik
2025 Chair, California Section, ACS

Upcoming Events

- **Topic**: Outreach in June: Exploration Stations at the Contra Costa County Library:

Location	Date	Time
Dougherty Station Library	Friday, June 6	11:00- 1:00
Walnut Creek Library	Wednesday, June 11	11:00- 1:00
Brentwood Library	Wednesday, June 18	11:00- 1:00
Hercules Library	Wednesday, June 25	11:00- 1:00

Lead: Charlie Gluchowski for June 6 ,11. Alex Madonik for June 18 and 25.

- **Topic:** 3rd Annual PRIDE & Juneteenth Celebration Picnic

  Date: Sunday, June 29th, 2025

  Location: Huckleberry Picnic Area, Roberts Regional Recreation Area, 10570 Skyline Blvd. Oakland Register here

  Time: 10:00 am- 3:00 pm.

  Cost: Free

- **Topic:** CalACS Team SF Aids Walk

  Date: Sunday, July 20th, 2025

  Location: Robin Williams Meadow – Gold Gate Fields Kezar Dr & Bowling Green Dr San Francisco

  Time: 10:00 am – 2:00 pm

  For Registration visit the CalACS website link https://calacs.org/event/aids-walk-sf/?instance_id=595

Encouraging Results from the CA Section SEED Program: Connections are the Key

By E. S. Yamaguchi

In 1968 ACS Council passed what would become SEED, Summer Experiences for the Economically Disadvantaged. "Each year, the program supports 350+ students with research opportunities with qualified mentors in both academia and industry, as well as providing a virtual summer camp to students focusing on college readiness and professional development, lab preparedness, and exposure to chemistry-related career paths."[1] This program was spearheaded by Alan Nixon, a member of the California Section.

Alan Nixon's idea gives economically disadvantaged high school chemistry students the chance to do chemical research for 9 weeks during their summer break. This is a paid internship. Some of you may not know of Alan Nixon, a past ACS president who would be 115 years old if still living. I was lucky enough to know him and his great idea. I have volunteered in this program for over 40 years as its coordinator.

SEED forms connections of all kinds. Here are a few examples.

You may know that CA Section SEED students are hosted by the University of the Pacific (UOP) in Stockton, CA. Based on the connection between two late chemists, Dr. Glenn Fuller of our Section and Prof. Silvio Rodriguez of UOP, the CA Section SEED program expanded to UOP about 25 years ago. This has allowed students from that area to participate in research even though UOP is in the Sacramento Section.

SEED students at UOP are also connected to the UOP Pharmacy School, since some mentors have come from there. This gives students insight into pharmacy as a career.

Connections happen between SEED students from different sites. This year a student assigned to UOP told me that he will be a freshman at Harvard in the fall of 2025. Living in Stockton, he was concerned about the many adjustments he'd most likely have to make. But, who to ask? A few years ago, Zon Moua, a student from the UC Merced (UCM) SEED site also went to Harvard, winning a SEED scholarship for his freshman year. He went on to win a renewable ACS Loconti scholarship for the remainder of his college career. He is now an upperclassman, and I was able to connect the 2025 UOP SEED student with him. Not that many students from Valley locations go to college in the East, so this connection was truly appreciated.

Zon spread the word about SEED to his childhood friend, and she did SEED at UCM, and then went to Yale, also winning the SEED scholarship. These connections are vital for these Valley students, since they don't know anybody who has had these experiences. Their parents did not attend college, a fact I learn from the hour-long interviews that I hold for each student applicant.

The SEED experience can be important for the college application essay. SEED is known at the elite colleges of the East. How do I know? From my decades-long connection to a SEED coordinator (Nadia Makar) on the East Coast who is a high school chemistry teacher. Before she had SEED students, no students went to Ivy League schools from her high school. Now, both the high school and the colleges are happy to have this SEED connection. So, even if Harvard or Yale gets an applicant from our Central Valley—where is that? --, they know SEED as a program that readies students for college. The coordinators have a fair amount of flexibility regarding the details of their programs, so no two programs are identical.

Sections should seek volunteer coordinators who will serve forever and grow the connections!

References:

1. ACS Project SEED Program : https://www.acs.org/education/students/highschool/seed.html

Parkinson's Disease Approved Drug Classes and Biologics in Development

Donald MacLean

There are times when a name is associated with a disease. Michael J Fox (actor), and Janet Reno (US Attorney General) are two names associated with Parkinson's Disease (PD). Michael J Fox, had early onset PD, classified when the disease appears before a person is 50 years old (40 years old), and he has been the public face for PD with his public interviews. About 10 -20% (< 40 years 5-10%) of PD diagnosis is classified as early onset PD (onset definition varies so the statistics vary). Most PD cases occur in people above 60 years old. PD reduces life expectancy and quality of life. Table 1 shows the reduced expected years and the expected years to live in the USA according to the US Social Security Administration at selected age points. As shown in Table 1, the earlier the PD onset, the greater the reduction of years a person can expect to live.

Table 1. Life Progression After Parkinson's Disease Diagnosed. [1, 2]

At age (years)	PD impact on life expectancy reduced (years)	Average US population life expectancy remaining (years)	
		Male	Female
55	10.1	24.14	27.77
65	6.7	16.95	19.75
75	3.5	10.65	12.49
85	1.2	5.65	6.72

Table 1 reduction in life expectancy does not differentiate the disease's severity on the values shown. People with atypical Parkinson's Disease, including Lewy body dementia (see below for definition), progressive supranuclear palsy (affects walking, balance, eye movements and swallowing), not responding to L-DOPA treatment, and multiple system atrophy (autonomic failure, parkinsonism, cerebellar impairment and corticospinal signs), have increased mortality compared to people with typical Parkinson's disease and people without Parkinson's disease. [3]

Parkinson's disease: 7.8 years survival

Atypical Parkinsonism: 2.7 years survival

Incidence of Parkinson's in the U.S.A.

About 90,000 people are diagnosed with PD each year, with 1.1 million living with PD in the USA.[4]

- Males are 1.5 times more likely to get PD than females.
- PD increases with age after 65+ with the average age of onset is around age 70. Parkinson's disease can occur in younger adults, but it is rare. When people younger than age 50 have the disease, it's known as early-onset Parkinson's disease.
- Incidence rates are higher in certain areas especially industrial manufacturing areas (exposure to toxins).
- Having one or more first-degree relatives, such as parents or siblings, with Parkinson's disease increases your risk.

Signs and Symptoms:

Parkinson's Disease (PD) and Alzheimer's have many of the same proteins and Lewy Body buildup upon examination. The most striking PD sign is the tremors which distinguish it from Alzheimer's. Parkinson's symptoms[5] may include:

- Tremor. This rhythmic shaking usually begins in the hands or fingers. Sometimes tremors begin in the foot or jaw.
- Slowed movement, also called bradykinesia.
- Rigid muscles.
- Poor posture and balance.
- Loss of automatic movements.
- Speech changes (softer or quicker, slurred or hesitant before talking, flat or monotone, without typical speech patterns).
- Writing changes (trouble writing, may appear cramped and small).
- Nonmotor symptoms. These may include depression, anxiety, constipation and sleep problems. They also may include acting out dreams, needing to urinate often, trouble smelling, problems with thinking and memory, and feeling very tired.

Physiology:

In Parkinson's disease, nerve cells in the brain called neurons slowly break down or die. Many Parkinson's disease symptoms are caused by a loss of neurons that produce a chemical messenger in the brain. This messenger is called dopamine (DOPA). Figure 1 shows the chemical structure for L-DOPA. Figure 2 shows the PET brain scans for a normal and in a PD patient. The uptake of the F-18 labelled L-DOPA is less in a PD brain.

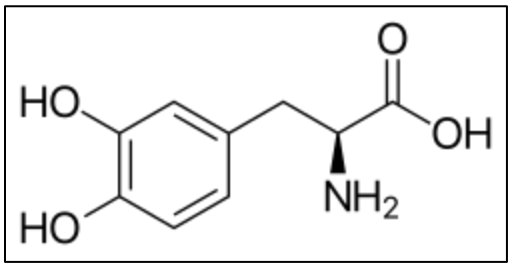

Figure 1. L-DOPA Chemical Structure.[6] L-DOPA is l-3,4-dihydroxyphenylalanine, the left-handed version of DOPA.

3 things that are noted in the PD Brain: Lewy Bodies, aggregated protein associated with Lewy bodies, and altered mitochondria. Lewy bodies (LB) are protein inclusions containing disaggregated oligomers of many cellular proteins (listed above). Lewy bodies may be surrounded by neurofibrillary tangles (intracellular aggregates of hyperphosphorylated tau protein).

A Lewy body is composed of:

1. Ubiquitin, 8.6 kDa regulatory protein, the addition of this to a substrate affects proteins in many ways: it can mark them for degradation via the 26S proteasome, alter their cellular location, affect their activity, and promote or prevent protein interaction.[9]
2. Neurofilament protein, series of protein 56 to 200 kDa, present in cytoskeleton of neurons, and increased levels are a marker of damage.[10]

3. alpha B crystallin, 22 kDa heat shock protein family and functions as molecular chaperone that primarily binds misfolded proteins to prevent protein aggregation.[11]
4. Tau proteins (s) [**t**ubulin **a**ssociated **u**nit] may also be present, maintaining the stability of microtubules in axons.[12]
5. α-synuclein, 15 kDa neuronal protein involved in the regulation of synaptic vesicle trafficking and the release of neurotransmitters.[13, 14]

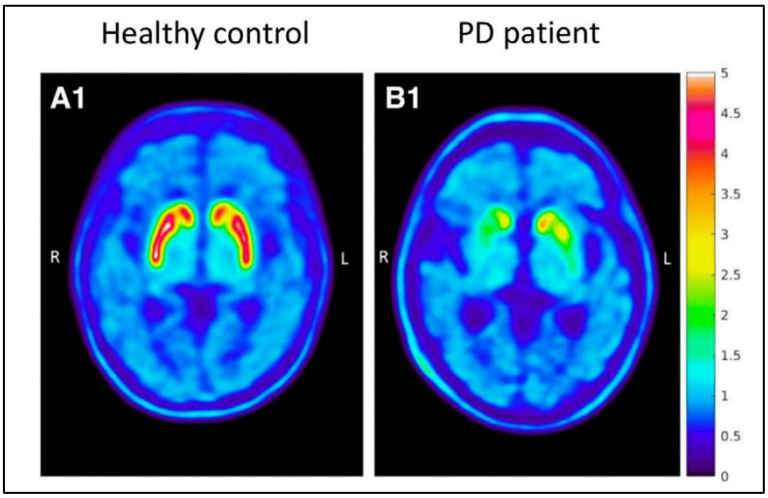

Figure 2. Reduced radioisotope F-DOPA (F-18 labeled L-DOPA) uptake in the striatum of a Parkinson's patient, captured through PET (positron emission tomography).[7]

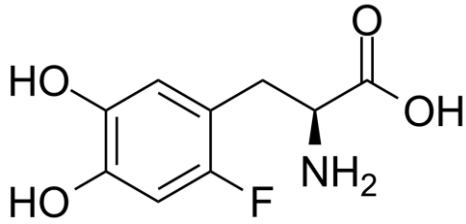

Figure 3. Fluorodopa Chemical Structure using Fluorine-18 isotope.[8] The Short half-life of F-18 results in on-site synthesis.

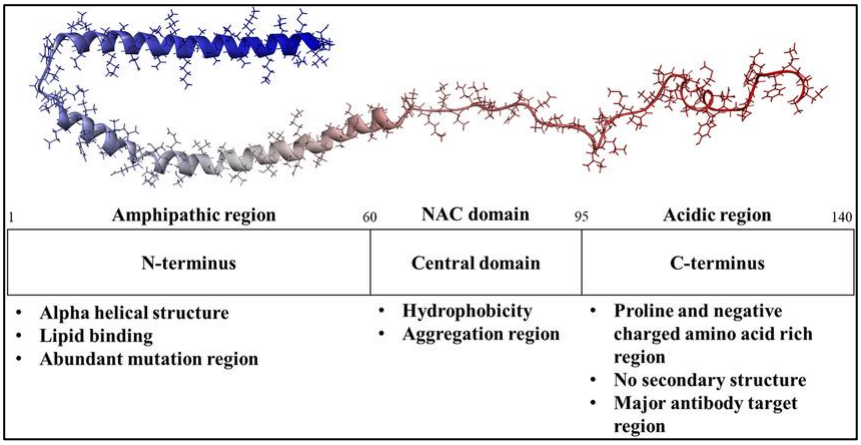

Figure 4. Alpha Synuclein Secondary Structure Scheme. The NAC domain is hydrophobic region where successive alpha-syn come together to form oligo then aggregates alpha-syn. [15]

Figure 4 shows the alpha-synuclein model structure with 3 domains. The NAC domain is hydrophobic. Misfolded protein rather than cross-linking or some other interaction causes oligo l multimeric interactions. This mechanism is determined using fluorescence dyes like Thioflavin T and ANS (8-anilino-1-naphthalenesulfonic acid). Figures 5 and 6 show staining for these structures. Table 2 shows the medication drug classes and their mechanisms. These approved medications are small molecules which require daily, sometimes multiple times during the day administration and only treat the symptoms, not providing a cure.

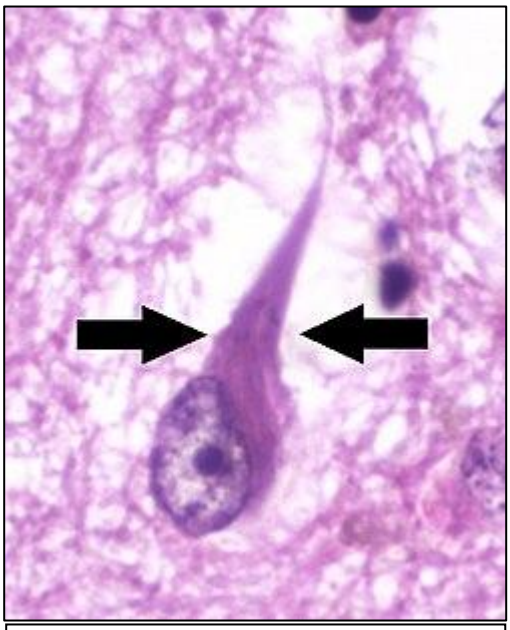

Figure 5. Microscopy of a cell with neurofibrillary tangles (marked by arrows).[16]

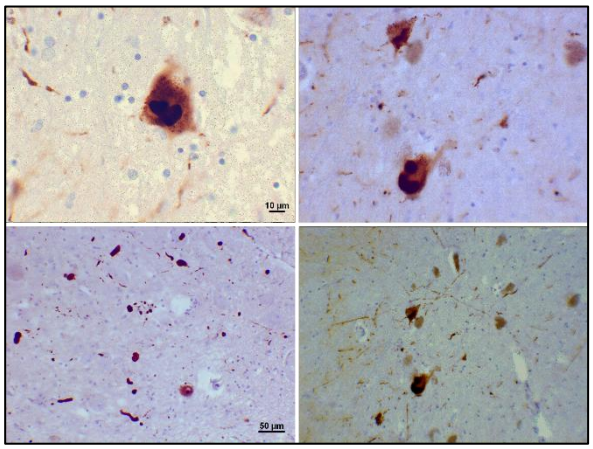

Figure 6. Mouse anti syn and Mayer's haematoxylin (a nuclear counter stain) produces the blue color. Lewy bodies and Lewy Neurites are brown.[17]

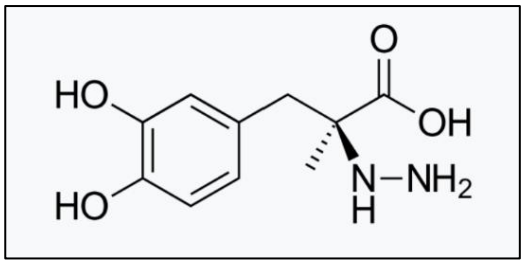

Figure 7. Carbidopa Chemical Structure.[19] The amine group has been modified.

Medications:

PD disease is treated using small molecules taken orally. Biologics are in development and clinical stages.

PD Cell and Gene Therapy Approaches:

Different companies are pursuing the potential behind various investigational therapies. At the forefront of research are approaches designed to:

1. **Regrow the dopamine system.** This method injects a gene intended to act as a growth factor, or fertilizer, to stimulate brains cells to regrow the dopamine system.
2. **Replace lost dopamine.** This method injects a gene that converts existing cells to produce dopamine. These could replace the need for dopamine-replacement medication.
3. **Rescue dying cells.** New research holds the potential to rescue dying cells, which could offer a path toward disease modification. This type of investigation is designed to interfere with PD and slow progression.

Cell and gene candidate therapies are shown in Tables 3 and 4.

Table 2. Approved Parkinson's Disease Medications.[18] Agonist = produces a response by binding to a receptor on the cell. Antagonist = opposes the action by binding to the receptor by blocking the site.		
Drug Class	**Dosage Form**	**Mechanism**
Carbidopa-levodopa	Oral tablets or suspension USAN / INN Name	Converts into dopamine in brain.
Dopamine agonist	Oral tablet, injection, sublingual film, dermal patches Bromocriptine Ropinirole Pramipexole	Substitutes for dopamine.
Monoamine oxidase Type B (MAO-B)	Oral tablet Selegiline Rasagiline Safinamide	Blocks breakdown of dopamine.
COMT inhibitors (catechol-O-methyltransferase)	Oral tablet or capsule Entacapone Tolcapone	Prevents levodopa deactivation to 3-O-methyldopa before entering blood stream.
Glutamate agonist	Tablet, syrup, capsule Amantadine	Reduces tremors.
Anticholinergics	Oral tablet / liquid Trihexyphenidyl HCl Benzotropine	Decreases movement by blocking acetylcholine.
Adenosine A2a antagonist	Oral tablet Istradefylline	Blocks adenosine at the adenosine A 2A receptor.

Vaccine Approach:
The vaccine produces antibodies to alpha-synuclein oligomers inhibiting oligomer growth. Table 5 lists 4 drug candidates, with one company out of business.

Antibody Approach:
Table 6 lists the antibody approach candidates. The antibodies are infused IV and target aggregated alpha-synuclein. Locally Genentech, a subsidiary of Roche, is working on antibodies (?).

Molecular Chaperone Approach:
A chaperone is a molecule that helps a protein function (fold) properly. This helps to improve clearance of cellular garbage, including α-synuclein aggregates.[20]

New Parkinson's Trails:[21, 22]

In the Biotech world the Cell Therapy and Gene Therapy approaches receive the most attention. Locally Bayer (Berkeley) is working with Blue Rock on an intracerebral stem cell approach. Bayer is also working with AskBio on a gene therapy approach. Gene therapy concept has not been financially successful due to the upfront list price for several drugs and the availability of alternatives. A series of regulatory approved gene therapy drugs have been withdrawn due to lack of sales. The cell therapy approach has been much more successful, many using CAR-T for cancer treatment.

Table 3. PD Cell Therapy Trials.[23, 24] The cells are administered at the target site. iPSC = Induced pluripotent stem cell		
Company Product	Route Source	Mechanism
Bayer / Blue Rock [25] (Ontario, Canada) Bemdaneprocel Phase 3	Intracerebral Allogeneic stem cell derived (derived from another human)	Replace dopamine-producing neurons lost in Parkinson's disease.
Aspen Neuroscience [26] (San Diego) ANPD001 Phase 1 / 2a	MRI-guide injection into a brain region Patient skin cells are converted into dopaminergic neuron precursors.	Replace the lost dopaminergic neurons with new ones.
S.Biomedics [27] (China) A9-DPC Phase 2	Intracerebral Embryonic Stem Cell-derived A9 Dopaminergic Neuronal Precursor Cells	
iRegene Therapeutics (China) NouvNeu001 Phase I/II	Intracerebral derived from iPSC	Human Dopaminergic Progenitor Cells Injection

Table 4. Gene Therapy Products in Development. Note the gene is incorporated into a delivery vector.		
Company (location) Product Phase	Route Source	Mechanism / Comment
Bayer / AskBio [25] (Durham, NC) AB-1005 (AAV2-GDN) Phase 2	Intracerebral Delivered via AAV2 vector	Human glial cell line-derived neurotrophic factor (GDNF) genes
MeiraGTx [28] (New York) AAV-GAD Phase 2	One-time infusion	Delivers glutamic acid decarboxylase (GAD) enzyme to increase gamma-aminobutyric acid (GABA).
Prevail Therapeutics/Eli Lilly (New York) PR001 Phase 1 / 2	One-time injection into the cerebrospinal fluid in the cisterna magna Delivered via AAV9 vector	Also being developed for Gaucher Disease.

Table 5. Vaccines. Antibody drugs targeted against aggregated forms of α-synuclein. [29]		
Company (Location) Product	Type and Target	Route Continuance
Vaxxinity (Merritt Island, Florida) UB-312	Synthetic peptide vaccine	No cost estimate Company has gone dark.
AFFiRiS (Vienna, Austria) AFFITOPE PD01A	Peptide-based vaccines Designed to generate an immune response against the oligomeric forms of α-syn	Acquired by AC Immune in 2021
AFFiRiS PD03A	Peptide-based vaccines Designed to generate an immune response against the oligomeric forms of α-syn	Subcutaneous injection
AC Immune (Lausanne, Switzerland) ACI-7104.056	Peptide-based vaccines α-syn	Subcutaneous injection

Table 6. PD Antibody Candidates.		
Company (Location) Product	Type and Target	Route Studied Continuance
Hoffmann-La Roche (Basel, Switzerland) Prasinezumab	Humanized IgG1 monoclonal antibody targeting aggregated alpha-synuclein	1 hour IV infusion
Biogen [30] (Cambridge, MA) Cinpanemab	Monoclonal Antibody with high affinity for aggregated than for monomeric	Terminated
AstraZeneca [31] MEDI1341 Indenebart	Monoclonal Antibody mono and aggregated α-synuclein	60 min IV infusion every 4 weeks for 8 weeks
Lundbeck A/S [32] (Denmark) Lu AF82422	Humanized monoclonal IgG1 Antibody α-synuclein	IV every 4 weeks up to 72 weeks

Assessing the Cost: [33]

Current Therapies

- **Small Molecule Medications:** The annual cost for Parkinson's medications can range from $2,500 to $6,000 per year, depending on the specific drugs and dosages required.
- **Deep Brain Stimulation (DBS):** The initial cost for DBS surgery is $35,000 to $50,000, with additional costs for device maintenance and battery replacements every few years.

Prospective Therapies

- **Stem Cell and Gene Therapies:** The upfront costs are high, though may offer long-term financial benefits by potentially reducing the need for continuous medication, multiple surgical interventions, and reduced skilled care. The cost of stem cell therapy can range from $50,000 to $800,000, depending on the type of stem cells used and the complexity

of the procedure. Gene therapy costs based on other products would be 1 to 5 million per dose.

- **Antibody and Molecular Chaperone:** Multiple administrations treatment such as antibody drugs ranges from $30,000 to $300,000 per year. Small molecule chaperone in theory can be cheap, but can be super expensive for something so simple. See Fabry Disease [GALAFOLD® (migalastat)] example for molecular chaperone that is both a small molecule and expensive. [34]
- **Vaccine:** unsure about costs.

Insurance Coverage

Most insurance companies do not cover stem cell therapy or gene therapy for Parkinson's as it is often classified as experimental. Several ongoing clinical trials are already testing treatments for people who carry certain PD gene variants in LRRK2 and GBA.

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Municipal Water Has High pH to Prevent Corrosion
The Langelier Saturation Index, Well Water, and Tooth Decay

Donald MacLean

Well water and surface water are dirty, have microbes, and can be corrosive. Municipal water is not any of those things, well at least from a drinking standpoint, but does need further cleanup for pharmaceutical and chemistry uses. To achieve drinkable quality, municipal water goes through purification, and has additives such as fluoride and chlorine added, and the pH adjusted. What is surprising is how high the pH is at the tap. It is not pH 5 to 7, but municipal water is pH 8 to 9. Di-ionized water (DI water) is corrosive, but from a different cause, it is too pure. Water for Injection (WFI) is corrosive on metal pipes even though the water is not as pure as DI water. This month's topic is the Langelier Saturation Index (LSI) and how it is used to estimate how corrosive water is, both at the municipal level, and for those who use well and surface sources such as lake water.

The Langelier Saturation Index (LSI) is an unbiased measure of water balance. Most water treatment facilities use the LSI as can be seen from the delivered water pH, and carbonate content. In the 1930s, Dr. Wilfred Langelier, while at UC Berkeley, developed his saturation index for boilers to determine if the water is corrosive or scale-forming using pH, temperature, hardness, total dissolved solids, and alkalinity as parameters. In short, the LSI tells us calcium carbonate ($CaCO_3$) saturation. It turns out that calcium carbonate has both a beneficial and detrimental effect on pipes. The bad is narrowing pipes from calcium carbonate (scale). The good is the protective effect against corrosion as it creates a protective layer against metal corrosion. The acceptable LSI range is between -0.30 to +0.30 LSI. Table 1 shows the LSI and the magnitude for corrosion and scale forming. LSI is only a tool as corrosion can happen through additional methods like salt (sea water), electrical current (stray current, or galvanic corrosion), water velocity, and oxidation (dissolved oxygen) that are not part of the LSI calculation.

Table 1. Saturation Index and Its Interpretation.

Saturation Index	**Description**	**General Recommendation**
-5	Severe Corrosion	Treatment Recommended
-3	Moderate Corrosion	Treatment Recommended
-2	Moderate Corrosion	Treatment May Be Needed
-1	Mild Corrosion	Treatment May Be Needed
-0.5	None- Mild Corrosion	Probably No Treatment
0	Near Balanced	No Treatment
0.5	Some Faint Coating	Probably No Treatment
1	Mild Scale Coating	Treatment May Be Needed
2	Mild to Moderate Coatings	Treatment May Be Needed
3	Moderate Scale Forming	Treatment Recommended
4	Severe Scale Forming	Treatment Recommended

If the LSI is -0.31 or below, water is aggressive because it is under-saturated with calcium carbonate. Above +0.31, the water has too much dissolved $CaCO_3$, so it begins to precipitate $CaCO_3$ out as scale, plaster dust, or other forms of $CaCO_3$.

How to calculate the LSI?

There are five or six factors that make up the LSI calculation. The original LSI had five factors because it was made for boiler systems, not swimming pools. I will not use the cyanuric acid stabilizer, the sixth parameter, which is used for swimming pools. You will have to look this up if you are using LSI for your pool. The following are the parameters that make up the LSI.

- pH
- Water Temperature (converted to K)
- Calcium Hardness (as $CaCO_3$) ppm
- Carbonate Alkalinity (as $CaCO_3$) ppm
- Total Dissolved Solids (TDS) ppm which can be done using conductivity (µS/cm) and converting to TDS ppm units.

Each parameter has a factor assigned to it that requires mathematical processing, except for pH. pH plugs directly into the LSI formula. The formula is simple enough, except when it comes to alkalinity.

There are 2 parts for the LSI, the measured pH, and a pH correction factor, pHs.

$LSI = pH - pH_s$

Where pH is the measured pH, $pH_s = 9.3 + A + B – C – D$

In which:
9.3 is a constant
A = Total Dissolved Solids in mg / L expressed as (log [TDS] – 1) / 10
B = The temperature in K is represented by 34.55 – (13.12 log T)
C = Hardness, in mg $CaCO_3$ / L is represented by log $[Ca^{2+}]$ – 0.4
D = Total alkalinity, in mg $CaCO_3$ / L is represented by log $[CaCO_3]$

If you are going to calculate the LSI, I recommend going through the calculation the hard way, not using the convenient conversion tables as the tables I have located over the years have systematic errors. [1, 2, 3]

Note the following effects. A small amount of TDS, calcium, and calcium carbonate have greater relative effect than a large amount due to the log function for those parameters.

Important Definitions

Total Dissolve Solids, TDS, can be determined by evaporation or by conductivity.

The permanent hardness of water is determined by the water's cation concentration with charges greater than or equal to 2+. Usually, the cations have a charge of 2+, i.e.,

they are divalent. Hard water includes Ca^{2+} and Mg^{2+}, known for making soap scum, as well as iron and manganese ions.

Alkalinity is the strength of a buffer solution composed of weak acids and their conjugate bases. This is not the term that is used in the acid – base lexicon. It is measured by titrating the solution with an acid such as HCl until its pH changes abruptly, or it reaches a known endpoint where that happens. It is a capacity factor.

Apply LSI with Water Treatment

To figure what your local municipal water company's water quality is see the reference to Figure 1 as a starting point to identify the company. If you have a well, pond, river, or lake as a direct water source you will have to do some testing yourself.

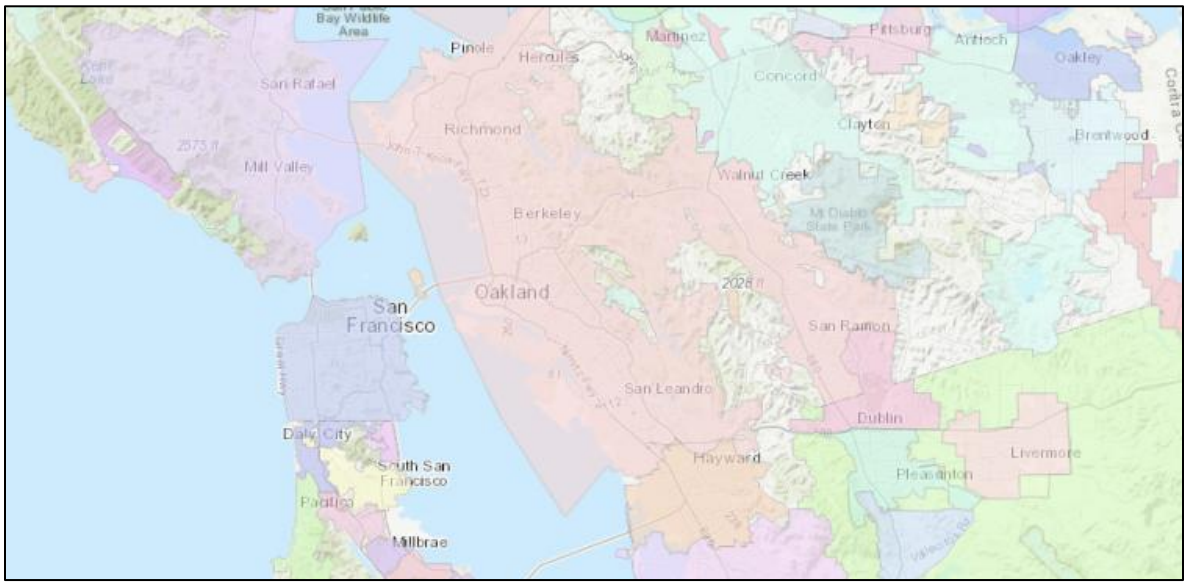

Figure 1. Snip and Clip Map Water Districts for California.[4] As you focus in, the name of water districts appears. Go to the reference to find your water district if you have municipal water.

Table 2 shows that locally the municipal water (EBMUB, SFPUC, Marin Municipal Water District) has pHs above 8. As a comparison I selected water from the Bluegrass state known for its low iron - high carbonate water as an example. Note the lower pH and the higher hardness level.

Calcium, carbonate, and pH are the big factors in LSI values. You must have higher pH to compensate for lower calcium carbonate concentration.

Table 2. LSI Calculations for Selected Water Sources. Fluoride value is added since added fluoride is for tooth decay inhibition.[5, 6, 7, 8]

	EBMUD		Marin Municipal Water District	SFPUC	Kentucky American Water
	2024 Walnut Creek (range)	2024 San Pablo / Sobrante (range)	2023 Water from Sonoma County Water Agency (average)	2023 San Francisco (average)	2021 Kentucky river Station (average)
pH	9.2 - 9.3	8.3 - 8.6	8.1	9.2	7.5
TDS (ppm)	ND - 54	140 - 180	168	84	66
Temperature (°C)	16 #	16 #	16	16	16
Hardness as $CaCO_3$ (ppm)	13 - 22	69 - 96	118	46	134
Alkalinity as $CaCO_3$ (ppm)	17 - 25	67 - 85	134	46	73
LSI	-0.55 to 0.23	-0.09 to 0.85	+0.21	+0.47	-0.55
Fluoride (ppm)	0.7 - 0.8	0.6 - 0.7	0.7	0.6	Highest 0.75
Iron (ppb)	Not listed	Not listed	Not listed	19	Not detected at ppm level
Chloride (ppm)	4	12-16	9	8.7	13.3

East Bay Municipal Utility District provides a range for locations, not an average.

Marin Water receives water from their reservoirs and from Sonoma County Water Agency.

SF Public Utility Commission report also has local ground water and reservoir test results, but not enough to perform LSI calculations. The values presented are from blended water sources. EBMUD adds calcium hydroxide (lime) and sodium hydroxide (caustic soda) to the water.

Not provided so will use 16 degrees Celsius.

The recommended fluoride level is 0.7 ppm.[9]

Figure 2 shows the USA water LSI map from various ground water samples. There are huge areas that are not covered such as Kentucky which is known for high carbonate-low iron water. California has a mix of corrosive and scale forming water. Note that this is for ground water, not surface water.

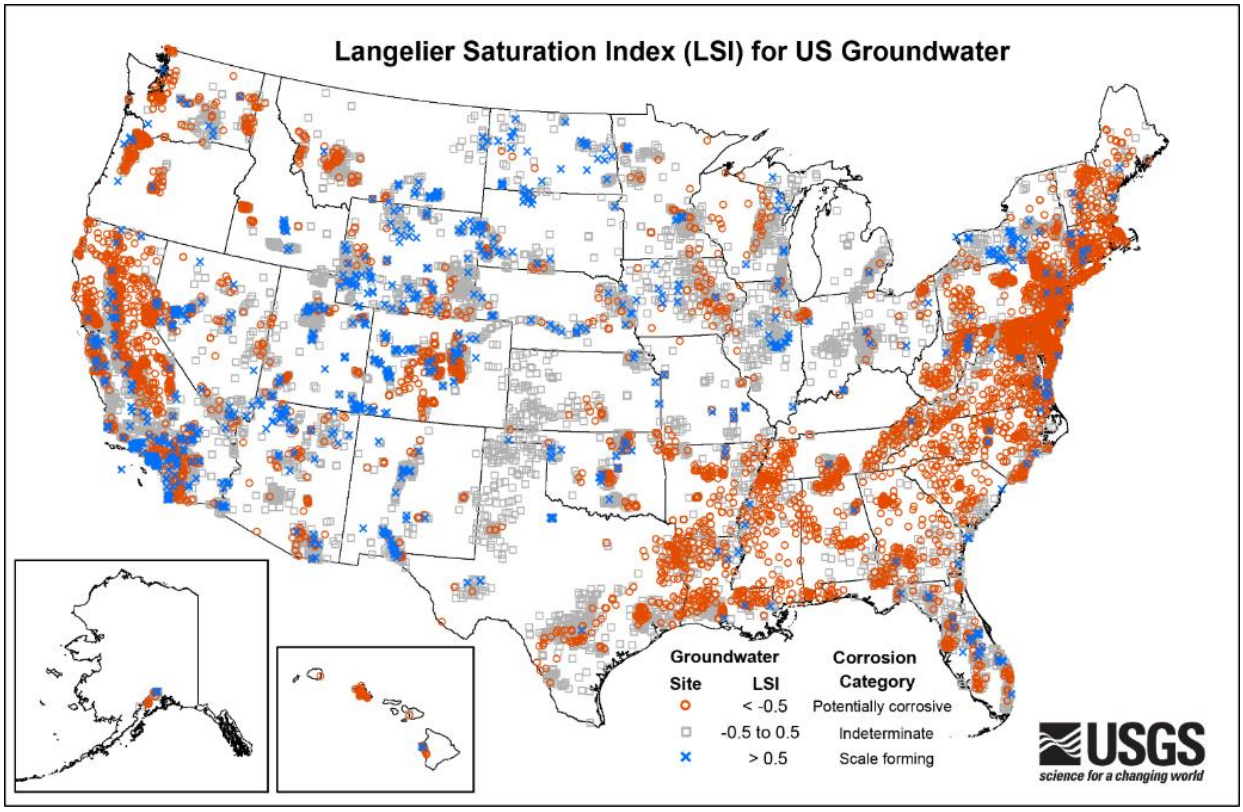

Figure 2. The LSI for Ground Water in the USA. [10] This is different than water hardness as LSI has other factors other than calcium and magnesium in its calculations.

How do you apply LSI to prevent corrosion in well and surface water? Assess the water using test strips or send it to a testing facility. Table 3 shows well water extracted from the ground that has a lot of iron, as noted by the yellow color. If the water is black, it could be manganese, white solids calcium carbonate, if green, it is copper pipe being corroded, and if it smells of rotten egg, hydrogen sulfide. There are a lot of other things that are left out here. In this case the water has a flow activated bleach injection system and an average 20-minute contact time holding tank before going through filtration. The water is tested prior to the bleach injection, after the iron filtration, and after the limestone flow through. The disadvantage with using bleach injection is that the organic compounds can be chlorinated. The test strip has three types of chlorine listed. The following are defined for chlorination.

- Free chlorine is hypochlorous acid (HOCl) and hypochlorite ions(OCl^-) in the water that is available for sanitizing and oxidation.
- Combined chlorine: Chlorine that has reacted with contaminants.
- Total chlorine is sum of free chlorine and bound chlorine.

Many people in the countryside use well (aka bore) or surface collection, whether off a roof, from a lake, river, etc. A lot of times well water needs treatment to eliminate iron, arsenic, fluoride, tannin, microbes, methane, sulfide, etc. One thing that has changed over the years is the switch from iron pipe to plastic pipe to move water. Iron pipes are more sensitive to rust and the corrosive water, while plastic pipes are inherently weaker and subject to cracking and coming apart. In house copper pipe water distribution is a better material, providing the water is not corrosive and the water flow rate is not too high. The Clean Water Store has a technical section dealing with water treatment issues that you can look at to see all the issues that wells may have to deal with. I am going to deal with low pH, iron, and sulfide well water as that is a frequent problem.[11] In general ground water pH is acidic if it has contact with carbon dioxide, organic decay materials, acidic cations like aluminum, and rocks like iron pyrite. Ground water is basic if it permeates through soil that has basic cations such as calcium, magnesium, sodium, and potassium found in rocks like limestone / marble. An example corrosive well water with high iron concentration is shown in Table 3. The initial water coming from the well is rated corrosive. Manganese, hydrogen sulfide, and iron bacteria are also present.

Table 3. Well Water Corrosiveness During Iron Removal. Tests done using Water test kit strips and conductivity meter. The added calcium carbonate after the bleach injection step is from ground limestone (Calcite, $CaCO_3$) and Corosex (MgO) percolation.

	Pumped out of ground prior to any treatment	After bleach but before limestone percolation	After limestone percolation
pH	5.5	6.6	7.0
TDS (ppm)	200	200	100
Temperature (°C)	16	16	16
Hardness as $CaCO_3$ (ppm)	0	0	40
Alkalinity as $CaCO_3$ (ppm)	0	0	40
LSI	-8.21	-7.49	-1.59
Description	Severe Corrosion, the iron pipe lasts about 6-8 years.	Severe Corrosion	Moderate Corrosion
Iron (mg/L)	10 ppm		
Total Chlorine (mg/L)	0		
Free Chlorine (mg/L)	0	3	

The ferrous curse and its cure:

Water containing ferrous iron is clear to yellow, and with air exposure the water turns red color. Ferrous iron is noted for yellow and brown toilet bowl staining and yellowing of the laundry whites. A water softener can remove low levels (up to 1 ppm) of iron via ionic exchange, but this makes ground water salty with the wastewater returning to the earth via the leach lines. When dealing with 10 ppm iron, the best remediation method is to oxidize the ferrous iron to ferric iron which precipitates as iron (III) hydroxide and is easier to remove using ion exchange. Adding or injecting chlorine (via non fragrance bleach), and permanganate are the most common oxidation methods. Hydrogen peroxide and

ozone (via a generator) can also be used [Figure 3]. Ferric iron solubility decreases with higher pH. One advantage of oxidizing iron is it also removes manganese and hydrogen sulfide. Manganese II leaves black stains and gives the water an oily feel if the iron is removed but a bit of manganese is still in the water. Hydrogen sulfide imparts a rotten egg smell to the water. Iron Bacteria are chemotrophic bacteria that derive energy by oxidizing dissolved iron can also be present and are eliminated though proper design. They naturally occur in soil and water, especially in wells, springs, and reservoirs. They form deposits of "rust" and a slimy material that can clog pipes and plumbing fixtures and are very noticeable with seepage through pipe joints.

Figure 3 shows chemical oxidation reactions in acidic condition. Aeration is practical at large scale water treatment facility, but at small scale this oxidation method is too slow and takes up too much space. Four common chemical oxidative methods are chlorine, permanganate, hydrogen peroxide, and ozone.

Figure 3. Oxidation Methods

Ferrous acidic condition

Hypochlorite: $2\ Fe^{2+} + 2\ OCl^- + 4\ H^+ \rightarrow 2\ Fe^{3+} + Cl_2 + 2\ H_2O$

Permanganate: $5\ Fe^{2+} + MnO_4^- + 8\ H^+ \rightarrow 5\ Fe^{3+} + Mn^{2+} + 4\ H_2O$

Hydrogen peroxide: $2\ Fe^{2+} + H_2O_2 + 2\ H^+ \rightarrow 2\ Fe^{3+} + 2\ H_2O$

Ozone: $2\ Fe^{2+} + O_3 + 2\ H^+ \rightarrow 2\ Fe^{3+} + O_2 + H_2O$

Manganese acidic condition

Hypochlorite: $Mn^{2+} + 4\ H^+ + 6\ OCl^- \rightarrow MnO_4^- + 3\ Cl_2 + 2\ H_2O$

Permanganate: $3\ Mn^{2+} + 2\ MnO_4^- + 2\ H_2O \rightarrow 5\ MnO_2 + 4\ H^+$

Hydrogen peroxide: $Mn^{2+} + H_2O_2 \rightarrow MnO_2 + 2\ H^+$

Ozone: $Mn^{2+} + H_2O + 3\ O_3 \rightarrow MnO_2 + 2\ H^+ + 3\ O_2$

Hydrogen sulfide

Aeration: $H_2S + ½\ O_2$ ----> $H_2O + S$

Chlorine: $H_2S + 4\ Cl_2 + 4\ H_2O$----> $H_2SO_4 + 8\ HCl$

Permanganate: $16\ MnO_4^- + 9\ H_2S$ ---> $12\ MnO + 4\ MnO_2 + 9\ SO_4^{2-} + 8\ H_2O + 2\ H^+$

Ozone: forms sulfur then sulfur dioxide then sulfite then sulfate.

My favorite oxidation method is chlorine using bleach (5 to 6% sodium hypochlorite) or “liquid chlorine” (10 to 12% sodium hypochlorite) by slow injection when the well pump is on (Continuous method). The bleach cannot be fragranced as that would contaminate the water. Another benefit for bleach is that the pH is raised as bleach is basic. Chlorine tablets (trichlor [Trichloro-S-Triazinetrione] and cyanuric acid) (Figure 4) found in the pool section are not suitable for drinking water. The main problem from chlorine oxidation is the creating of chloro organic compounds and the high chloride concentration is not good for plants. An activated carbon filter to remove the excess chlorine / chloride may need to be used to eliminate the residual chlorine in the water.

Permanganate is also popular as it does not leave that chlorine smell in the water, but the amount needed must be adjusted seasonally to add enough to do the job without having too much to cause the water to be pinkish-purple.

Hydrogen peroxide is also acceptable but is the most expensive option and too much residual hydrogen peroxide is toxic.

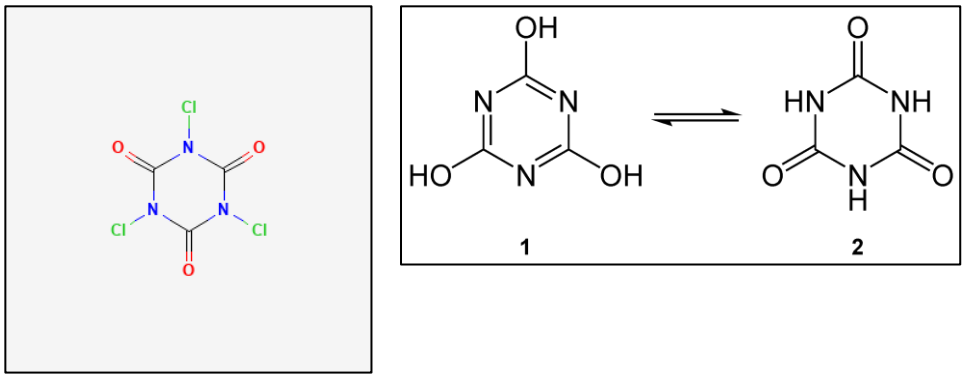

Figure 4. Left: Trichloro-S-Triazinetrione Chemical Structure. [15] Right: Cyanuric acid chemical structure. [16]

Finally, ozone is an option that is the most expensive to set up and strongest oxidizer commonly available.

Table 3 shows the initial water prior to treatment. Note the high iron level. The water has yellow tint. With bleach injection, and contact time the ferrous iron is converted to ferric iron which is less soluble and precipitates. The bleach also raises the pH from about 5.5 to pH 6.4 to 6.8, which reduces the LSI by approximately 1 unit. The water goes through an iron entrapment filter followed by a 5-micron particle filter. The LSI is less negative but still is considered corrosive. The water then goes through crushed limestone to raise the pH and add calcium carbonate. The calcium carbonate should go after the bleach injection but before the particle size filter. The small amount of added carbonate adds 6 LSI units to the negative value.

Manganese II (manganous) is also oxidized by the four mentioned methods to manganese IV oxide.

What is interesting is the oxidation of hydrogen sulfide by aeration leads to elemental sulfur, sulfuric acid by chlorine, and to potassium sulfate by permanganate.

Iron removal is best explained with product solubility (Table 4). Oxidizing the iron and raising pH lowers the iron concentration.

Table 4. Ferrous Iron, Manganese II, and Hydrogen Sulfide Oxidation in Water Solubility.[17]		
	Ksp at 25 °C	Comment
$Fe(OH)_2$	1.8 x 10^{-15}	1.8 x 10^{-1} M [Fe^{2+}] or 9992 ppm at pH 7
$Fe(OH)_3$	4 x 10^{-38}	4 x 10^{-17} M [Fe^{3+}] – precipitates at pH 7
MnS (green)	3 x 10^{-14}	
$Mn(OH)_2$	5.61 x 10^{-12}	561 M [Mn^{2+}] (impossible) at pH 7 But divalent Mn 0.10 to 1.0 ppm at surface and ground water conditions. pH 5 = 0.0561 M = 3.08 g / L
MnO_2	insoluble	
H_2S		Rotten egg smell, solubility at 20 C - 0.117 mM
S	insoluble	
H_2SO_4	soluble	
K_2SO_4	soluble	

Drinking Water Limits Iron and Manganese.

The Safe Drinking Water Act secondary standards (aesthetic, not health related) for iron in drinking water is 0.3 parts per million (ppm) and 0.05 ppm for manganese.[18]

Comment about Reverse Osmosis (RO) and Activated Carbon Filters

A whole house RO system uses a lot of water and usually will have a prefilter to collect particulates. This system uses a backflush every 15 min to 2 hours. By itself it is not practical and does not solve the corrosive issue if they exist.

An activated carbon filter will not take out the iron and prevent corrosion. However, after the oxidation treatment, it is a good method to remove excess chlorine to protect plants and remove that familiar chlorine smell.

Fluoride in Water

Another issue with water quality is adding fluoride to the municipal water to prevent tooth decay. There are areas where there is too much natural fluoride in the water, which is a health concern leading to skeletal fluorosis**.** There is controversy with adding fluoride to water with complaints including thyroid issues (fluorine and iodine are halogens) and decreased IQ. Teeth have an enamel surface that are composed of hydroxyapatite crystals (calcium, phosphate). Is adding fluoride, raising the pH, and low LSI the reason there is less tooth decay when we use municipal water? Fluoride is a weak acid conjugate which acts as a buffer. Currently two states passed laws to prohibit adding fluoride in public water (Utah, Florida).

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Pavlath Legacy: The *Our Society* Newsletter (1971 – 1982)

Nicki Davis

In the previous article, we described Attila's petition drive to get Alan C. Nixon's name on the ballot for President-Elect in 1970 and 1971, and Alan's subsequent election as ACS President-Elect for 1972. But that was only the first step. Attila knew he also had to get more people who supported – or at least did not oppose — Alan C. Nixon's ideas on professionalism to be elected to the ACS Board of Directors.

This article describes how Attila brought about this transformation: by publishing *Our Society: The Newsletter of the Chemical Grassroots*. As the newsletter name implies, Attila used it to promote a grassroots movement to make the ACS more accountable to its members. Members needed to be informed about where candidates for ACS president and other board members stood on the issue of professionalism and on Alan C. Nixon's slogan: "The first responsibility of the ACS is to its members." As we shall see, Attila had to adjust his campaign strategy to comply with guidelines from the national organization.

Alan C. Nixon's First Presidential Run

For Alan C. Nixon's first run for President-Elect in 1970, Attila had had only six weeks to get the required number of signatures to put Alan's name on the ballot. He not only reached out to members in other sections whom he knew, but also scrutinized the directories of other sections for names of members. In those pre-internet days, many sections published directories of their membership with contact information that included not only the names of employers, but also members' home addresses and even phone numbers. The California Section, for example, published a membership directory once per year in *The Vortex*. The newsletter existed only as hardcopy that was sent to members via postal mail, so the method was more secure than today's email.

Attila announced the results of the first petition campaign for Alan C. Nixon in the November 1970 issue of *The Vortex*. His announcement is worth quoting in full, because it illustrates the tactics that he would use in subsequent years:

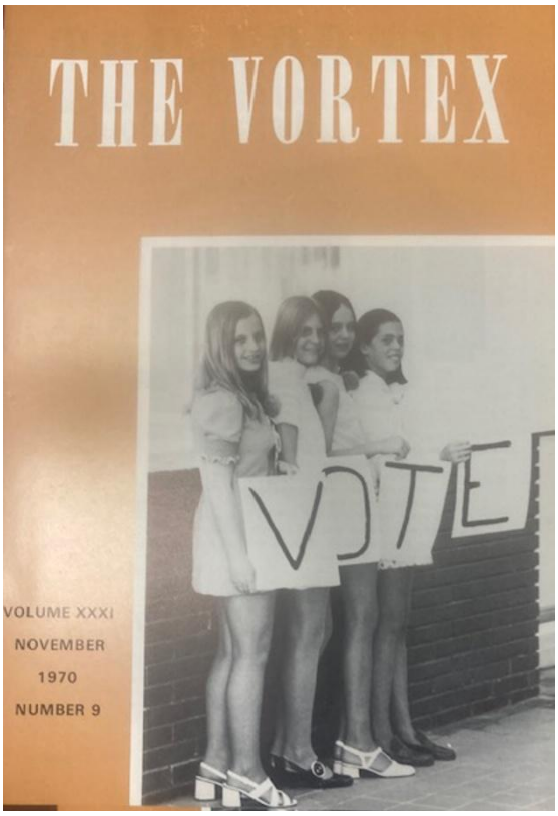

Figure 1: Issue of The Vortex with cheerleaders urging members to vote. The caption reads, "These lovely young ladies, Pam Inger, Lonnie Hearne, Grace Pavlath, and Debbie Pattillo, present a graphic exhortation to make your voice heard in two important elections for national and local section officers. Vote for the candidate of your choice, but V-O-T-E!"

NIXON IS THE ONE!

We are happy to announce that Al Nixon was nominated by a landslide as a grassroots candidate for President-Elect. This is the first time in the history of the ACS that someone has been nominated for the highest office of our Society based *on his stand on the policies of the ACS*. Almost ten times as many signatures were collected as required. More than two-thirds of them came from outside of our Section – from Florida to Washington. In the process we also succeeded in nominating Dr. Edward Lewis of Rice University and Dr. Adalbert Farkas of Philadelphia as "grassroots candidates" for Director-at-large.

The nomination of Alan Nixon, however, is only half way to success. We still have to elect Al in order to bring about changes in the ACS. We need your help urgently.

1. If you have chemist friends in other parts of the country, urge them to vote. We have a form letter available. It needs only addressing, signing and mailing. Just give us a call (848-0512 day or 524-4699 night) and tell us how many you need.
2. If you have not given "at the office" yet, please, help us to defray campaign expenses. The more we have, the more publicity we can get. The majority (60-70%) of the members never bothers to vote. Your contribution can help to make them realize that this year is different. It could be the best investment made for your professional future. (A. C. Nixon Campaign Fund, 2140 Shattuck Ave., #1101, Berkeley 94704).
3. Don't forget to vote. Every vote counts!

ATTILA E. PAVLATH
on behalf of the NIXON for
PRESIDENT-ELECT Campaign.

Figure 2. Copy of Attila's Letter.

As Attila's letter indicates, his petition drive not only collected signatures for Alan C. Nixon's nomination as President-Elect, but also for nominees for Director-at-large on the ACS Board of Directors. The procedures for nominating Directors-at-large were the same as those for President-Elect, so the only way to get a grassroots candidate for these positions on the ballot was to nominate by petition. To encourage members to vote, Attila even had his daughter Grace and three of her high school classmates pose for a photo on the cover of the November 1970 issue of *The Vortex* (Figure 1).

Alan Nixon's Second Presidential Run: Our Society

Alan C. Nixon's strong showing as a petition candidate in the 1970 election came as a big surprise to the national ACS leadership. The leadership therefore decreed that

future petition drives could not use the resources of the California Section: no funds, no articles in *The Vortex*, not even office space. To solve this problem, Attila started his own newsletter, *Our Society: The Newsletter of the Chemical Grassroots*, in 1971.

Attila took care to see that the newsletter was produced completely independently of the California Section and that none of the Section's resources were used in the campaign. Even the name of the newsletter had to be changed from *Our Society: The Chemical Grassroots of the American Chemical Society*, to *Our Society: The Newsletter of the Chemical Grassroots* to comply with branding directives.

To fund the newsletter, Attila used the same strategy he had used for the petition drive for Alan C. Nixon's nomination in 1970: He asked members to make donations, and ordinary members supported the movement by sending donations of five or even ten dollars.

In the 1970 election, Attila had directed correspondence to the A. C. Nixon Campaign Fund at the California Section office in Berkeley: 2140 Shattuck Ave., #1101, which meant that the campaign was using the Section's office space. For subsequent elections, Attila used an ingenious strategy to acquire office space. "It turned out that the Section office was next door to the office of a friend of mine, a lawyer," he recalled. "We were in the same flying club. And he kindly agreed that I could use his address, which was 2140 Shattuck Ave., #1102 instead of #1101."

Attila's 1971 petition drive once again succeeded in getting Alan C. Nixon's name on the ballot for the election. Once Alan was nominated, Attila mailed flyers to members around the country, informing them that the choice between candidates wasn't only based on their scientific achievements, but on the basis of their stand on ACS policies. As mentioned in the previous article, Attila's management of Alan C. Nixon's election campaign enabled Alan to win election as President-Elect for 1972. Attila continued publishing *Our Society* for several years. "This is what started the whole revolution. I don't want to call it a revolution, because some people don't like [that term], so I call it upgrading," he recalled.

Newsletter activities after the 1971 ACS election

As ACS President, Alan could do a lot, but he couldn't do everything – he couldn't influence the nominating committee of the ACS Council on whom to nominate for president or other elected board members. To address this issue, the Grassroots would determine where the candidates nominated by the nominating committee of the ACS Council stood on the issue of professionalism. If a candidate was suitable, the Chemical Grassroots would endorse that person. If not, then Attila would conduct a petition drive to nominate a more suitable candidate. Either way, the Grassroots would run a campaign urging people to vote for the candidate they endorsed. For example, Alan's successor as president, Bernie Friedman, was a bench chemist nominated by petition in 1972 and became president in 1974. A succession of presidents in the next few years were either nominated by petition or endorsed by Grassroots: Bill Bailey (1975); Glenn Seaborg (1976); Henry A. Hill, the first African-American president of ACS (1977); and Anna J. Harrison, the first woman president of ACS (1978). Attila recalled that the best big-name scientist who became ACS president was Glenn Seaborg. Seaborg was a Nobel Laureate, as well as the only ACS member to have a chemical element named after him, so the ACS presidency was a relatively small honor for him. While he didn't support Alan

C. Nixon and Attila openly, as a board member he understood the situation and he supported the idea that the ACS needs to take care of its members. Gradually, candidates for president came to realize that they needed to say something about what they wanted to do to advance the professional interests of members.

Another important change was to get people elected to the Board who supported, or at least did not oppose, Alan Nixon's ideas on professionalism. As it turned out, rules for nominating people to the Board were similar to those for nominating for president: the nominating committee of the ACS Council would present a list of four candidates to the ACS Council and ask them to choose two from the list. In these cases, Attila's Grassroots movement would either endorse one of the candidates selected by the board, or would nominate a candidate by petition.

Some people have described the changes instituted by Alan Nixon, Attila, and the professionalism movement as a revolution. Attila, however, preferred to call it an "upgrade."

Moving forward with ACS service at the national level

At the same time that he was producing the *Our Society* newsletter, Attila was also serving the California Section as a member of the national ACS Council. The next article will describe his service on the Council, his first run for ACS President-Elect, and his subsequent election to the ACS Board of Directors as a Director-at-large.

WCC Guest Speaker: Natalie McClure, PhD

"From the Laboratory to the Marketplace"

On Saturday, May 10, Natalie McClure spoke to the CalACS Women Chemists Committee and friends about the regulatory aspects of new drug development. She is a Stanford PhD who started her career at Syntex in Process Development. Over the years, her role changed to Regulatory Affairs where she helped her employers comply with the Food and Drug Administration regulations. Her talk focused on the regulatory side of drug development.

The FDA issues regulations and approves medicines for humans and animals, as well as biologic drugs, vaccines, medical devices, and tobacco products. It establishes safety and purity standards for foods and vitamins, cosmetics, and radiation-emitting devices but does not approve them. For example, vitamins are considered to be dietary supplements, and thus, are foods rather than drugs. They do not go through the full approval process (This distinction was established by Congress.)

Potential new drugs go through extensive testing, both medical and chemical / pharmaceutical. Few ever reach the point of an approval application to the FDA. In the early stages, the drug is tested on bacteria and animals while chemical tests and manufacturing procedures are developed. If it looks like it is safe to use (low toxicity) and likely effective (good efficacy), the company prepares an Investigational New Drug (IND) application, requesting permission to test it in humans.

When the IND is approved, the first tests are done on healthy people to determine the best dose. The second phase of clinical testing uses larger numbers of people who have the disease. This determines the efficacy. The third phase of clinical testing involves more people who may be given the drug or a placebo (no drug) or an older drug. These tests are "double blind" because the patients and the medical personnel don't know whether or not they have received the new drug. Very few new drugs get to this phase; most are dropped due to lack of efficacy or toxicity. Meanwhile, chemists and pharmacists are developing the manufacturing process and the quality control tests. Shelf-life determination is part of the extensive chemical testing.

If the compound does cure the disease or condition, a New Drug Application (NDA) is prepared. It includes a huge amount of data from the medical testing, but also includes chemistry, manufacturing, toxicology, and many other sections. When the NDAs were submitted on paper, the triplicate volumes filled a tractor-trailer! Now all documents are electronic.

While the company is waiting for the FDA evaluation, they are negotiating the package insert (prescribing information). It often takes a year to get full approval of a new drug. Generic drugs and over the counter medicines have fewer requirements.

The Cal-ACS WCC thanks Natalie McClure for her excellent presentation!

Anne K. Taylor

Cal ACS at Lincoln Elementary School STEAM Night – May 13th, 2025

Cal ACS volunteers received a warm welcome when we returned to Lincoln Elementary School for STEAM Night (Science, Technology, Engineering, Art, and Math) on Tuesday, May 13th [note this is in Richmond]. Michael Cheng and I [Alex Madonik] arrived early to set up, and we were soon joined by the Chevron Slime Team (led by Deanna Quon and Maryam Deldar) and Mariana Alves, our stage show impresario. Lincoln School staff and Fab Lab Richmond were there as well with a wide range of hands-on activities.

Principal Taylor Parham and Vice-Principal Vranda Booker welcomed everyone, and then introduced me to the eager crowd (100+), so that I could introduce Mariana. Her stage show was a hit as always, with everything from sodium polyacrylate snow and Elephant's Tooth Paste to the big flame in a bottle and the acrylic-oxygen rocket.

Mariana Alves is ready to brush her pet elephant's teeth!

Welcoming the Chevron Slime Team

Then, it was time for some hands-on science (and math and art). Guided by Mariana and Michael, kids explored acid-base chemistry using red cabbage indicator, confirming that dry ice and the carbon dioxide in their breath are acids that turn the indicator pink. The full chemistry rainbow was on display as they added Milk of Magnesia to a stirred red cabbage indicator solution, followed by reactions with dry ice or vinegar.

Mariana explains acids and bases.

Making slime with Chevron.

At the other ACS activity table, kids learned about glaciers, icebergs, and the 2025 Chemists Celebrate Earth Week theme, “Glaciers: Hot Topic, Cool Chemistry.” They could see that the melting glacier was causing steady sea-level rise in one tank, while the sea level was not changing in the iceberg tank. Nonetheless, melting icebergs do change the salinity and the temperature profile of the ocean. Using blue-dyed ice cubes, kids could see that melting fresh water floats on top of red-dyed salt water (even though it is colder), but sinks in yellow-dyed fresh water. They also had the chance to observe freezing-point depression, with thermometers indicating different temperatures when ice melts in fresh vs. salt water; adding sodium chloride (table salt) or calcium chloride caused the freezing point to drop dramatically.

Monitoring sea-level rise as the glacier melts.

Melting ice water- float or sink?

No school science night would be complete without liquid nitrogen ice cream, and Michael made sure our friends at Lincoln school were not disappointed. The dedicated school staff

helped with stirring and serving, and everyone had as much as they could eat. Many thanks to all who helped make this event a success!

Michael and Chevron volunteers prepare ice cream, assisted by Lincoln Vice-Principal Vranda Booker.

Alex Madonik
2025 Chair, California Section, ACS

Cal ACS Awards Luncheon – May 18th, 2025

Alex Madonik and Norm Wu

We're delighted that so many Cal ACS members and friends were able to attend the annual Awards Luncheon on Sunday, May 18th, 2025 at Skates by the Bay in Berkeley. It was a beautiful day with breath-taking views of the Bay and the multitude of sailing craft trying their luck with waves and wind. Our guests also enjoyed the excellent service and varied menu choices offered by the restaurant. The real treat was seeing so many new and familiar colleagues, including the two newest additions to the families of our Councilors, Atefeh's son Daniel and Vanessa's son Coralie.

Equally remarkable was the opportunity to honor so many long-time members of the ACS: 50-year members Charlie Middleton, Harvey Trop, and Mark Wegner; 60-year members Ta-Sen Chou, Michael Coan, Hamid Kasmai, Kent Matsumoto, Jerry Sarquis, and Jerry Taylor; and 70-year members William Reusch and Hessy Taft. All received their official ACS service certificates, and had the opportunity to tell us something about their careers.

2025 Chair-Elect Jim Postma made the first official presentation, assisted by 2013 ACS President Marinda Wu. The 2025 Lloyd Ryland Outstanding Teacher Award recipient was Zeynep Araci, PhD of Basis Independent School, Fremont CA. Zenep teaches middle and high school to Honors and AP Chemistry classes. She has been an advisor to the Chem Club for students as an after-school program and mentors students for competitions such as science fairs, Chem Olympiads, and YBTC challenge.

I had the pleasure of introducing our 2023 Chair Atefeh Taheri, recipient of this year's Walter B. Petersen Award. This award is presented annually to a California Section member for outstanding service for an extended period to the Section. Atefeh has been a driving force in the California Section for the past five years and continues to develop innovative programming and events that engage members in industry as well as academia and the national labs. Marinda joined me in honoring Atefeh, and we went on to recognize each of the 50-, 60- and 70-year service awardees.

Many thanks to our office manager, Julie Mason, for making all of the arrangements with the restaurant and for tracking the list of attendees. I received a total of 21 certificates honoring 50-year members, 20 certificates honoring 60-year members, and eight certificates recognizing 70-year members, a remarkable total! With Julie's help, I was able to sort out the certificates for in-person presentation ahead of time, and she has since put the rest of them in the mail to our awardees.

Finally, warm thanks to Norm Wu for non-stop service as the event photographer!

ACS Service Awards:

50 Years	60 Years	70 Years
Bendict G. Archer	John A. Budny	Douglas W. Fuerstenau
Geoffrey J. Brooks	Robert J. Bussey	Edward L. Kean
James L. Brunk	Tony Man Kuen Chiu	Sheldon N. Lewis
Ross W. Fisher	Ta Sen Chou*	William H. Reusch*
David E. Garfin	Michael H. Coan*	Igor Sobolev
Benjamin U. Giang	David E. Earls	Richard F. Sullivan
Diana G. Graham	Carl D. Eben	Hessy L. Taft*
Karl R Grose	Douglas L. Eisner	
Ronald Poonke Ko	Sandra C. Greer	
Clay Larson	Hamid S. Kasmai*	
Michael A. Marletta	Larry L. Kirk	
Elizabeth H. Mei	Gerald T. Lisowski	
Barbara Oviedo Mejia	Kent E. Matsumoto*	
Charles E. Middleton*	Paul R. Ortiz De Montellano	
Christopher A. Pohl	Chai Fu Pan	
David W. Pointon	Jerry L. Sarquis*	
Philip N. Ross	L. Donald Shields	
Harvey S. Trop*	Gerald T Taylor*	
Mark M. Wegner*	John J. Vollmer	
Gordon J. Wozniak		
Simon M. Yeh		

(*Names in green received their awards in-person on May 18th.)

Marinda Wu (2013 ACS President) and Alex Madonik (2025 Cal ACS Chair) honor 50 year members
Charles Eugene Middleton, Christopher Andrew Pohl, Harvey Steward Trop, and Mark M. Wegner - 18 May 2025 © Norm Wu

Michael Henry Coan

Hamid Saleh Kasmai

Kent Edward Matsumoto

Jerry L. Sarquis

Marinda Wu (2013 ACS President) and
Alex Madonik (2025 Cal ACS Chair)
honor 60 year members
18 May 2025 © Norm Wu

Gerard Thames Taylor

Marinda Wu (2013 ACS President) and Alex Madonik (2025 Cal ACS Chair) honor 70 year members Willam Henry Reusch and Hessy L Taft - 18 May 2025 © Norm Wu

Jim Postma, Zeynep Araci, Alex Madonik, Marinda Wu.

Atefeh Taheri, Alex Madonik, Marinda Wu.

The 2025 Lloyd Ryland Outstanding Teacher Award recipient Zeynep Araci.

Alex Madonik

2025 Cal ACS Chair

Editor Note: from student trenches (student voice). This is a student AP Biology assignment to advocate for a scientific topic.

The Glowing Threat of Light Pollution

Marie-Claire McDavitt

What is Light Pollution?

Light pollution is the effect of artificial lighting making an area brighter at night than it would naturally be. While it is known for obscuring the stars, it also disrupts the travel of migratory species as well as our own circadian rhythms. Light pollution has been increasing at a rate of 10% per year in North America.

How Helpful Are Outdoor Lights?

Outdoor lights are one of the most obvious causes of light pollution, and while lights typically help us see in the dark, they aren't as useful as they first seem. They actually can make it harder to see outside at night because they prevent our eyes from adjusting to the darkness. Additionally they can create glare which obscures vision.

Light Pollution Effects on Wildlife

Light pollution confuses the navigation of many animals who use the stars to navigate like birds causing them to not reach food in time or get trapped in areas. Marine animals have been shown to avoid light sources, meaning light pollution from ships could be affecting marine ecosystems. Brighter night skies impair the ability for animals to hide from predators at night and while windows can be run into by birds who are confused by their light. Birds also often are attracted to rest at places with more light pollution, which have less food for them to gather and more windows.

Light Pollution Effects on Circadian Rhythms

Exposure to light, especially blue light, prevents the release of melatonin which is what makes people feel naturally tired at night. With the overabundance of light people struggle to fall asleep on schedule which can lead to chronic sleep deprivation or at least lower quality of sleep; both of which can worsen health issues.

How to Lower Light Pollution

Turning off lights at night when they aren't being used is the best solution as it also saves energy, but when lights need to be used, cover windows with curtains, shades or blinds to prevent light from escaping. Make outdoor lights motion sensitive so they are only lit when needed. Aim outdoor lights more downwards, so light is more efficiently used on the ground instead of being lost into the sky. Have lights on a timer so that they turn off every once in a while to let wildlife trapped by the confusing lights escape. Also using dimmer and warmer colored lights helps because they are less disorientating.

Annotated Bibliography

Bruno, L. (2024, June 26). *Light Pollution on Bird Migration Behavior*. Golden Gate Bird Alliance. https://goldengatebirdalliance.org/blog-posts/light-pollutions-effects-on-bird-migration-behavior/

Bruno discusses the importance of the Bay Area for migratory birds and how light pollution is luring birds to worse resting locations during their migration. She gives statistics on the increase in light pollution per year. She then provides methods to help lower light pollution like using dimmer or warmer colored light and putting timers on lights. It has good information on

how light pollution affects the local area specifically, but does not go into non wildlife effects of light pollution.

National Geographic Society. (2025, April 10). *Light pollution*. Education.nationalgeographic.org; National Geographic. https://education.nationalgeographic.org/resource/light-pollution/

The National Geographic Society first defines light pollution and how it is increasing, showing a map of light pollution across the globe and statistics. They then explain how light pollution harms visibility and circadian rhythms. They end with mentioning how air pollution worsens skyglow because of how particles in the air scatter light and providing a formula to calculate skyglow based on population and distance called Walker's Law. It has good statistics on light pollution and general effects, but does not discuss ways to solve the issue.

National Park Service. (2025, March 31). *Light Pollution - Night Skies (U.S. National Park Service)*. Www.nps.gov. https://www.nps.gov/subjects/nightskies/lightpollution.htm

The National Park Service starts out with defining light pollution and how common it is, referencing satellite images of the Earth. They explain how light pollution disrupts circadian rhythms by preventing the release of melatonin, causing many adverse health effects. They mention how light pollution changes the sleep-wake cycles of other animals, how it confuses migratory animals and how it alters the behavior of marine animals. They introduce several organizations trying to help prevent light pollution and emphasize the importance of using only the most necessary and efficient lights. It has very in-depth explanations of the effects of light pollution and offers some solutions, but is not specific on the effects seen in the Bay Area.