


Write to Publish



Outline

- What's publishable?
 - What's in a paper?
 - To make it easy
 - How to write:
 - Format
 - Abstract
 - Introduction
 - M&M
 - Results & Discussion
 - Conclusions
 - References
 - Figures/Tables
 - Final touches
-



What's Publishable?

□ New ideas

- New compounds (not likely)
- New topics (less likely)

□ New data

- Address current issues
- Issues of regional interest

□ Small but provable topics

- Small improvements
-



Field vs. Laboratory

- Field data:
 - Monitoring, scattered data – less publishable
 - Field plot studies (expensive) – highly publishable
 - Lab studies:
 - Inexpensive
 - Publishable, if done right
 - Lab-field combinations
 - Complementary
 - Most publishable
 - Example: Analytical methods + field samples
-



What's in a Paper?

□ How long?

- 12-15 text pages, double spaced
 - 1-4 tables
 - 5-2 figures
 - 15-25 references
 - 2-4 core references
-



To Make It Easy

- Always read other people's papers first!
 - Avoid “reinvent the wheel”
 - Avoid wasting time on developing old methods
 - Avoid becoming “narrow minded” - fair evaluation of your own work
 - Really get the “handle” or “angle”
 - Aim low, aim small, aim specific
 - Really, really understand “why?”
 - To be used in Introduction
-



To Make It Easy

- Always prepare a study protocol
 - Notebooks: date/time
 - Plan 1, plan 2, ..., keep updating
 - Objectives
 - Detailed methods, exact conditions, references
 - Detailed statistics, design
 - Incorporate changes
 - Record problems, unexpected observations
 - Store all info in specific folders

 - To be used in M&M
-



To Make It Easy

- Analyze data when still “hot”
 - Get data off instruments right away!
 - Plot after 3 time points!
 - Group curves by treatments
 - What do you want to compare?
 - Temperature? In one graph
 - Compounds? In one graph
 - Soil type? In one graph
 - Keep samples for 6 months after finish
 - Recap if punctured
 - Always use replicates ($n \geq 3$) and statistics
 - r or r^2
 - Try to use internal standards, or run samples at approximately the same time



Format

- Always:
 - Double space
 - Page number
 - Add line number
 - Left justified
 - Font: 12 pt, Times New Roman
 - 1st page: Title, author info
 - 2nd page: Abstract, (keywords)
 - 3rd page: Introduction (< 2 page)
 - M&M: < 5 pages
 - Do not place figures in text!
 - Do not start a sentence with a numerical or abbreviation!

 - Habits, habits...
-



Abstract

- ❑ Most important (go over 10+ times)!
 - ❑ Write after finishing most of manuscript
 - ❑ <200 words or <18 lines
 - ❑ Start with “why” (2-3 sentences)
 - ❑ Followed by “In this study, ...” (what was done; 2-3 sentences)
 - ❑ Followed by results (2-3 sentences): include numbers!
 - ❑ Followed by conclusions
 - ❑ End with “significance”
-
- ❑ Emphasize uniqueness, impact
 - ❑ Spelling check!

ABSTRACT

Halogenated fumigants are some of the most heavily used pesticides worldwide. A number of studies have shown that fumigant transformation in soil is correlated with soil organic matter content. However, relatively little is known about the mechanisms of fumigant interaction with soil organic matter. In this study, we used ^{14}C -labelled 1,3-dichloropropene (1,3-D) and methyl bromide (MeBr) to characterize their incorporation into soil organic matter and the association of bound radioactivity with the different organic matter components. The ^{14}C activity of bound residues increased with time, and reached 38-49% for 1,3-D and 37-42% for MeBr after 72 d of incubation at 25°C. More bound residues were produced for 1,3-D than for MeBr in the same soils. The distribution of ^{14}C activity in soil humic substances followed the order of fulvic acids >> humin > humic acids. These observations suggest that incorporation into soil organic matter is the predominant pathway for transformation of halogenated fumigants in soil, and fulvic acids are likely the most significant sink of all soil organic matter fractions. It is further speculated that bound residues formed as a result of alkylation of organic matter by the fumigants through nucleophilic replacement.



ABSTRACT

Chiral pesticides currently constitute about 25% of all pesticides used, and this ratio is increasing as more complex structures are introduced. Chirality occurs widely in synthetic pyrethroids and organophosphates that are the mainstay of modern insecticides. Despite the great public concerns associated with the use of insecticides, the environmental significance of chirality in currently used insecticides is poorly understood. In this study, we resolved enantiomers of a number of synthetic pyrethroid and organophosphate insecticides on chiral selective columns, and evaluated occurrence of enantioselectivity in aquatic toxicity and biodegradation. Dramatic differences were observed between enantiomers in their acute toxicity to freshwater invertebrates *Ceriodaphnia dubia* and *Daphnia magna*, suggesting that the aquatic toxicity is mostly attributable to only a specific enantiomer in the racemate. In field sediments, the (–) enantiomer of *cis*-bifenthrin or *cis*-permethrin was preferentially degraded, resulting in relative enrichment of the (+) enantiomer. Enantioselective degradation was also observed during incubation of sediments under laboratory conditions. Enantioselectivity in these processes is expected to result in ecotoxicological effects that cannot be predicted from our existing knowledge, and must be considered in future risk assessment and regulatory decisions.



Introduction

- Most difficult to write
- Write after M&M
- Key point: justify “why”
 - Aim low, aim small, aim specific
 - Thorough understanding of published studies
 - Fair evaluation of existing information
- Start with problems, sources, big picture issues, ...(1st paragraph)
- Followed by specific review
 - Do not undermine other researchers!
 - Only include useful/relevant studies
 - Always “praise” previous findings
- Followed by a gap or an unclear topic
- Followed by “In this study, we ...”, or “The main objective of this study was ...”
- End by the potential usefulness of the expected information: “The results from this study may be used ...”
- About 4 paragraphs; < 2 pages!

INTRODUCTION

Halogenated hydrocarbons form the majority of soil fumigants. In particular, methyl bromide (bromomethane, MeBr) has been heavily used for several decades due to its broad spectrum of activity against nematodes, arthropods, weeds, fungi, and bacteria. However, the potential contribution of MeBr to stratospheric ozone depletion will result in a complete MeBr phase-out in 2005 in the U.S. and other industrialized countries (1). Most of the probable chemical alternatives are also halogenated fumigants. These include 1,3-dichloropropene (1,3-D) and chloropicrin, which are already in widespread use, and methyl iodide (iodomethane, MeI) and propargyl bromide (bromopropyne, PBr), which are being considered as potential alternatives (2-4). All of these compounds have very high vapor pressures, and have been shown to quickly volatilize after soil incorporation (5-8). Atmospheric emission of fumigants is an environmental or health hazard, because many fumigants are acutely toxic and potentially carcinogenic (7). Evaluation of fumigant emissions and mechanisms has attracted great research interest over the last decade. Transformation in soil has been identified as the most important process in reducing fumigant emissions (9).

Fumigant transformation can be mediated by both chemical and microbial processes (10-12). For halogenated fumigants, the rate of fumigant transformation has been shown to depend closely on soil organic matter content (10, 13-16). For instance, transformation of MeBr, 1,3-D, and MeI was more rapid in soils with higher organic matter content or after amendment of organic materials such as compost, and the enhanced transformation occurred also in sterilized soils (13-14, 17). All these observations suggest that soil organic matter is involved in the abiotic transformation of fumigants in soil. In separate studies, Papiernik et al. (15-16) showed that transformation of PBr or MeBr proceeded at similar rates in sterile and non-sterile soils,

and little propargyl alcohol or methanol was produced from the transformation. This implies that abiotic processes predominated fumigant transformation, and hydrolysis was not the main transformation pathway. In a recent study, using solid-state ^{13}C NMR, Tao and Maciel (18) observed bond interactions between MeBr and whole soil samples or soil organic matter components. While the study offered direct evidence to the hypothesis that MeBr alkylated organic matter in soil, the actual contribution by this pathway to the overall abiotic transformation was not known.

The main objective of this study was to evaluate the role of organic matter in fumigant transformation in soil by following the formation and distribution of non-extractable or bound residues. Bound residues are defined as the fraction of pesticides that is non-extractable after exhaustive extraction (19). Bound residues commonly occur as a result of irreversible interactions between pesticides and soil organic matter. The fumigants 1,3-D and MeBr were used as the test compounds in this study. The same mechanisms should apply also to the other halogenated fumigants of similar structures, including MeI, PBr, and chloropicrin.

Introduction

The significance of molecular chirality is widely recognized in life sciences (1, 2). A lesser known fact is that many modern pesticides also contain chiral structures and thus consist of enantiomers (3, 4). About 25% of currently used pesticides are chiral, and this ratio is increasing as compounds with more complex structures are introduced into use (3). Enantiomers of the same compound have identical physical-chemical properties, thus appearing as a single compound in standard analysis. For economic reasons, chiral pesticides are mostly used as mixtures of enantiomers, or racemates. However, enantiomers are known to selectively interact with biological systems that are usually enantioselective, and may behave as drastically different compounds. The role of enantioselectivity in environmental safety is poorly understood for pesticides, and the knowledge gap is reflected in that the great majority of chiral pesticides are used and regulated as if they were achiral, that is, as single compounds.

Studies on chiral pesticides started to appear in the early 1990s (4, 5-12). Studies so far show that microbial degradation of chiral pesticides is commonly enantioselective. As one enantiomer is preferentially degraded, the enantiomer ratio (*ER*), defined as the ratio of (+)-enantiomer over (–)-enantiomer, increasingly deviates from the original value (typically 1.0) (8, 9). Enantioselectivity was found to result in changes of *ER* of α -HCH along the polar bear food chain, causing *ER* to increase from about 1.0 in cod to 2.3 in liver samples of polar bear (10). In the brain tissue of seals around Iceland, often only (+)- α -HCH was found, while (–)- α -HCH was absent, giving indefinitely large *ER* values (5, 13). Enantioselectivity has also been observed under laboratory conditions for the soil degradation of some chiral herbicides and fungicides, including metolachlor, metalaxyl, and dichlorprop (4, 8, 14).

Most environmental research on chiral pesticides has thus far been limited to a few legacy chlorinated insecticides whose use was discontinued decades ago, and some herbicides or fungicides. Little is known about currently used chiral insecticides. Many current insecticides have high activity against non-target organisms and are also chiral. In particular, two classes of insecticides, synthetic pyrethroids (SPs) and organophosphates (OPs), are acutely toxic to a wide range of aquatic organisms at trace levels (15, 16). Contamination of surface aquatic ecosystems by these compounds is a great environmental concern (17, 18). All known SPs have chiral structures and contain 4 or 8 enantiomers (19), while many OPs are also chiral, consisting typically of 2 enantiomers (20). However, although these compounds are in wide use, enantioselectivity in their environmental behavior is almost unknown (21).

In this study, we developed chiral-selective chromatographic methods to separate and isolate enantiomers from a number of SPs and OPs. Individual enantiomers were used for characterizing their differences in acute toxicity to two indicator aquatic invertebrates, *Ceriodaphnia dubia* and *Daphnia magna*. Enantioselectivity was further evaluated for SPs during their biodegradation in sediments under field and laboratory conditions.



Materials & Methods

- Easiest to write
- Write first
- Structure/arrangement
- Sub-headings:
 - Add “experiments”...
 - Chemicals (1 paragraph; no structures; no properties)
 - Soils (source, properties, brief description of handling and analysis)
- Group treatments so they correspond to Results and Discussion
- Info on exact steps, word by word description
 - Avoid general statements
 - Details, details, details!
 - **Write so that other people can repeat!**



M&M

□ Flow chart:

- Chemicals: names, full chemical names, purity, sources
 - company name without “Inc.” or “Co”, city, state abbreviation
 - Soils/sediments: source, handling (size, air drying), properties (OM, pH, texture), analysis
 - Scientific names for soils
 - Specific treatments/experiments
 - Chemical analysis
 - May be combined into experiments
 - Spell out terms (HPLC, GC,...) when first used; abbreviate thereafter
 - Exact conditions: temperatures, flow rate (double check)
 - Retention times
 - Calibration methods
 - Recoveries, detection limits
-

MATERIALS AND METHODS

Soils. Two different types of soil were used in this study, a Chualar loam (fine-loamy, mixed, thermic Argixerol) from Salinas, California, and a Waukegan silt loam (fine silty, over sandy or sandy-skeletal, mixed, mesic Typic Hapludoll) from Rosemont, Minnesota. The basic soil properties were analyzed before the study (Table 1). The soil organic carbon content was determined using the Walkley-Black method (20), and particle sizes were determined using the hydrometer method (21). These soils were passed through a 2-mm sieve without air-drying and stored at 4°C before use.

Chemicals. Methyl bromide (>99% purity) was obtained from the Great Lakes Chemical Company (West Lafayette, IN). Carbon-14 labelled MeBr with a specific activity of 3.1 mCi mmole⁻¹ and radiochemical purity of >97% was synthesized by the New England Nuclear Co. (Boston, MA). The standard of 1,3-D (48% cis isomer and 49% trans isomer) was purchased from Chem Service (West Chester, PA). Carbon-14 labelled 1,3-D with specific activity of 1.11 mCi mmole⁻¹ and radiochemical purity 98.6% was provided by Dow AgroSciences, LLC (Indianapolis, IN).

Incubation Experiments.

The moist soil samples were pre-incubated for a week at room temperature to revive soil microbial activity. To prepare the spiking solutions, both ^{14}C -labelled and unlabelled MeBr or 1,3-D were dissolved in ethyl ...

Preparation of ^{14}C -bound Residue Samples.

The soil samples were thawed at room temperature and transferred to 50-ml centrifuge tubes, followed by aeration in a fume hood overnight to remove any untransformed parent compound or volatile ...

Fractionation of ^{14}C -bound Residues.

Bound residues derived from the previous incubation experiments were fractionated into fulvic acids (FA), humic acids ...

Radioactivity Measurement.

The radioactivity in HA and FA fractions was measured directly on a Packard Tri-Carb 1600TR Liquid Scintillation Analyzer (Packard Instrument Company, IL) after mixing with 5 ml Ultima Gold Cocktail (Packard, CT). Combustion of solid samples was carried out on an OX-500 biological oxidizer (R.J. Harvey Instrument Corp., Hillsdale, NJ). The total time of oxidation was 4 min, and the temperature was 900°C . The $^{14}\text{CO}_2$ evolved from combustion was trapped in 15 ml Carbon-14 Cocktail (Harvey, Hillsdale, NJ), and the radioactivity was determined by LSC. The efficiency of $^{14}\text{CO}_2$ recovery, as determined by combusting ^{14}C standards, was determined to be $>97\%$. A 5-minute interval was used for all samples for radioactivity counting by LSC.

Materials and Methods

Chemicals. Analytical standards of racemic (Z)-*cis*-bifenthrin [$> 96\%$, 2-methylbiphenyl-3-ylmethyl (Z)-(*IRS*)-*cis*-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate)], fonofos [99.4% , *O*-ethyl S-phenyl (*RS*)-ethylphosphonodithioate], and profenofos [$> 93.7\%$, *O*-4-bromo-2-chlorophenyl ...

Chromatographic Separation and Analysis. Enantiomers were resolved and isolated on an Agilent 1100 Series high pressure liquid chromatography (HPLC) (Wilmington, DE) with chiral columns. After testing with a suite of commercially available columns, resolution of SP enantiomers was achieved on a Sumichiral OA-2500I column (Sumika Chemical Analysis Service, Osaka, Japan), using 99.5% hexane and 0.5% 1,2-dichloroethane as the mobile phase. Resolution of OP enantiomers was achieved on a Chiralcel OJ column (Daicel Chemical Industries, Tokyo, Japan) using 98% hexane and 2% ethanol (containing 5% methanol and 5% isopropanol) as the mobile phase. The injection volume was $20\ \mu\text{l}$ and the UV wavelength for detection was $230 \pm 15\ \text{nm}$. The polarity (i.e., rotation sign) of the resolved enantiomers was determined by an in-line laser polarimeter detector (PDR-Chiral, Lake Park, FL). The light source for the chiral detector was a laser ($675\ \text{nm}$) and the cell path was $50\ \text{mm}$. The resolved enantiomers were individually collected at the HPLC outlet, evaporated to dryness, and used in aquatic toxicity bioassays. Concentrations were determined using peak area, by assuming the same response factor for enantiomers originating from the same compound. ...

Aquatic Toxicity Assays. Enantioselectivity in aquatic toxicity was evaluated through 96-h acute toxicity assays using *Ceriodaphnia dubia* and *Daphnia magna*. The overall procedure for the test was similar to the EPA guidelines (22). Test animals were supplied by Aquatic Biosystems (Fort Collins, CO). Briefly, test solutions (15 mL) containing a given ...

Analysis of Field Sediments. Sediments containing residues of *cis*-bifenthrin and *cis*-permethrin were collected at a site next to a nursery in southern California, and were used for evaluation of changes in *ER* as a result of natural attenuation. The dried sediment was accumulated from surface runoff over a four year period. Samples were taken using ...

Incubation Experiments. Enantioselectivity in SP degradation was further evaluated through incubation experiments. Sediment samples were collected from a sedimentation pond and a runoff channel at a nursery site in southern California. The pond sediment contained 0.65% organic carbon and 5% clay, while the channel sediment contained 6.4% organic carbon and 19% clay. Compared to sediments used in the above experiment, sediments from the sedimentation pond and channel were newly deposited. The sediments were sampled from the surface layer (0-5 cm) and used without air-drying to preserve the original microbial activity. Five grams (dry ...



Results and Discussion

- ❑ Relatively difficult to write
 - ❑ Think through what's important
 - ❑ Combine Results and Discussion
 - ❑ Break into 2-3 sections with headings
 - ❑ Some results followed by some discussion
 - ❑ Followed by extrapolation
 - ❑ **Avoid pure speculation!**
 - ❑ Leave major conclusions to the end
 - ❑ **Use references for argument (2-4 references)**
 - ❑ **Use topic sentences**
-

RESULTS AND DISCUSSION

Mass balance. In this study, the recovery of ^{14}C activity after organic matter fractionation ranged from $86 \pm 4.0\%$ to $112.7 \pm 7.9\%$ for 1,3-D-derived bound residues, and from $82.5 \pm 2.8\%$ to $109.9 \pm 7.2\%$ for MeBr-derived bound residues. ...

Total bound residues in soil. Figure 1 shows accumulation of bound residues in the Waukegan silt loam and the Chualar loam after treatment of ^{14}C -labelled 1,3-D or MeBr. ...

Between the two fumigants, the fraction of bound residues was slightly greater for 1,3-D than for MeBr in the same soils at each incubation time. This was consistent with the observation that MeBr ...

Composition of bound residues. Bound residues of ^{14}C -labelled 1,3-D and MeBr were fractionated into FA, HA, and humin using the standard procedures for organic matter fractionation (Figures 2-4). ...

The ^{14}C bound residues in humin fraction was apparently higher in the Chualar soil than in the Waukegan soil throughout the incubation period. The activity with humin appeared to ...

The more dominant distribution of bound residues in the FA fraction over the HA or humin fraction was inconsistent with the observation by Tao and Maciel for (18). Using soil components isolated prior to MeBr exposure, Tao and Maciel (18) showed that there was formation of $^{13}\text{CH}_3\text{O}$ -moieties between MeBr and HA or humin, but not between MeBr and FA. ...

The rapid incorporation of fumigants into soil organic matter suggests that fumigants may be inactivated through this process. Previous studies have shown that the biological activity of most halogenated fumigants is caused by their ability to alkylate essential biological macromolecules such as proteins and DNA (28). Therefore, interaction of fumigants with soil organic matter, e.g., alkylation of FA and other organic matter components, should render the fumigant fragment inactive due to the loss of the nucleophile (i.e., Br in MeBr and Cl at the saturated carbon in 1,3-D). The increase in radioactivity with the humin fraction over time further suggests that the ^{14}C was no longer associated with the original compound, but became an integral part of the soil organic matter. Therefore, incorporation into soil organic matter may be considered a detoxification process for soil fumigants such as MeBr and 1,3-D.

(significance, application, needed research ...)

RESULTS AND DISCUSSION

Enantiomer Separation and Analysis.

Resolution of enantiomers was highly column-specific in both HPLC and GC analyses. In HPLC analysis, complete separation was achieved only on Sumichiral OA-2500I for SP enantiomers and on Chiralcel OJ for OP enantiomers (Table 1). In GC analysis, separation was achieved only on a BGB-172 column for *cis*-bifenthrin and *cis*-permethrin. Utilizing the current conditions, the (+) enantiomer of SPs consistently eluted prior to the (–) enantiomer on ...

Enantioselectivity in Aquatic Toxicity.

The acute aquatic toxicity was measured for individual enantiomers and racemates using *C. dubia* and *D. magna* as the test animals (Table 2). From the LC50 values for the racemate, all insecticides possess outstanding toxicity against *C. dubia* or *D. magna*, with $LC_{50} < 1 \mu\text{g L}^{-1}$. However, there consistently was a significant difference in LC50 between the two enantiomers of the same compound. Invariably, when one enantiomer showed high activity, the other enantiomer exhibited activity that was drastically lower. For the selected SPs, the (+) enantiomer was more active than the (–) enantiomer by 17-38 times (Table 2). The (–) enantiomer in *cis*-permethrin and *trans*-permethrin was so inactive that only a threshold of $6 \mu\text{g L}^{-1}$ was obtained for the LC50 against either *C. dubia* or *D. magna*. From the LC50 values measured for individual enantiomers, it was estimated that the ...

Enantioselectivity in Degradation. Enantioselectivity in degradation was evaluated for the selected SPs by studying changes in *ER* during degradation under field and laboratory conditions. Analysis of aged field sediment samples showed that all samples contained relatively high levels of bifenthrin and permethrin. The *ER* in commercial formulations was close to 1.0 for *cis*-bifenthrin (1.02) and *cis*-permethrin (0.99). The averaged *ER* value for *cis*-bifenthrin (1.02) remained close to 1.0 in the surface sediment (0-15 cm), but increased to 1.11 in the 15-30 cm layer, and further to ...

Ecotoxicological Implications. Occurrence of enantioselectivity in either degradation or toxicity alone would have limited environmental significance. For instance, if two enantiomers of a chiral compound have the same aquatic toxicity (i.e., non-enantioselective), changes in *ER* alone will not result in different effects on the organism, as the combined toxicity would remain unchanged in relation to time. Conversely, if enantioselectivity occurs only in toxicity but not in degradation, *ER* will remain unchanged over time and the ecotoxicological effects are predictable from the racemate. Although previous studies showed that legacy chiral insecticides and some chiral herbicides or fungicides could undergo enantioselective degradation in the environment, the ecotoxicological significance was not revealed, because enantioselectivity in ecotoxicity was not simultaneously ... Further studies are needed to characterize interactions of environmental factors, such as soil/sediment properties, vegetation types, Redox conditions, and microbial structures with enantioselectivity in the behavior of chiral pesticides. Both SPs and OPs have other modes of toxicological effects, but it is unknown if enantioselectivity also occurs in those processes. ... Given the widespread use of these insecticides, a more comprehensive understanding of the significance of enantioselectivity is imperative for improving risk assessment and regulation of these pesticides.



Conclusions

- ❑ Omit of possible
 - ❑ Incorporate into last paragraph of Results & Discussion
 - ❑ Offers a “closure”
 - ❑ Start with most significant findings, not what was done;
 - ❑ Followed by “significance”
 - ❑ End by mentioning future needed research
 - ❑ Always one paragraph; about ½ page.
-

As demonstrated in this study, a highly valuable application of SPME may be its use for improving K_d measurement for strongly adsorbing compounds. Many important environmental pollutants display strong adsorption potentials on sediments and soils. These include PCBs, PAHs, DDT and other chlorinated insecticides, synthetic pyrethroid insecticides, among others. Accurate measurement of K_d for these compounds may improve the prediction of their release from a contaminated sediment bed into the overlaying water, or of their elimination from a water column by adsorption to the suspended solids and the bulk sediment. However, the majority of the K_d values for these compounds published in the scientific literature were obtained using methods that do not properly distinguish the dissolved and DOM-adsorbed forms. It will be of great practical importance to revisit these compounds, and evaluate the potential underestimation in their K_d values using such methods as SPME.



References

- ❑ 15-25 references
 - ❑ **Avoid Internet citations!**
 - ❑ Avoid textbooks
 - ❑ Representative publications
 - ❑ Relevant publications
 - ❑ **Consistent format**
 - ❑ Cross check!

 - ❑ To arrange/format at the very end
-



Tables & Figures

- ❑ Tables are preferred
 - ❑ 1-4 tables, 5-2 figures
 - ❑ Avoid large tables, but may stack figures
 - ❑ Use correct format
 - ❑ Include r^2 , SD, S.E. values in tables
 - ❑ Use error bars in figures
 - ❑ Make table and figure captions stand-alone (self explaining)
 - ❑ Tables, followed by figure captions
 - ❑ No captions on figure pages
 - ❑ “printable” quality (font size, symbol size, line thickness, height-width ratio 4:5)
-
- ❑ Use Sigma Plot or other graphic software for figures
 - ❑ Avoid using Excel



Final Touches

- ❑ Correct all typos!
 - ❑ Familiarize yourself with references
 - ❑ Start long, and then gradually condense
 - ❑ Convert copied sentences into your own words!
 - ❑ Trim extra, non-essential words
 - ❑ Pay attention to format details (use of bold, italics, table and figure caption format, keywords?...)
 - ❑ Use a recent article from the same journal as example
 - ❑ Read a couple of times a day for 3-4 days or until you are happy with it yourself

 - ❑ Practice makes a master!
-



Response to Review Comments

- ❑ Sit on them for a few days
 - ❑ Sincere attitude
 - ❑ Compromise
 - ❑ Be professional
 - ❑ Consider every comment
 - ❑ Point to point
 - ❑ List responses in Reviewer #1, Q1, Q2, ...; Reviewer #2, Q1, Q2, ...
 - ❑ Show true effort
-