COLUMBIA UNIVERSITY
School of Professional Studies

Master of Science in Sustainability Management

SUMA SP5475: Material Flow Analysis for Circular Economy
Dates: Summer B (July 1–August 9), Tuesdays and Thursdays 6:10–8:00 pm Location: TBD
3 credits
[Area 3, Area 5]

Instructor:	Koichi S. Kanaoka, koichi.kanaoka@yale.edu, 407-967-8165
Office Hours:	TBD and by appointment
Response Policy:	I am reachable via email and generally respond within 24 hours on weekdays. I may respond on the weekend, but it is not to be expected.
Teaching Assistant:	TBD
Office hours:	TBD
Response Policy:	I am reachable via email and generally respond within 24 hours on weekdays. I may respond on the weekend, but it is not to be expected.

Course Overview

Material flow analysis (MFA) is the premiere tool for enabling society's transition to a circular economy at the local, regional, national, and global levels. As a fundamental tool used in the field of industrial ecology, MFA enables researchers and practitioners to measure and track the flows, stocks, and fate of resources consumed by society (i.e., socio-economic metabolism). MFAs also yield valuable perspectives for climate change mitigation through integration with life cycle assessment models. Data on resource flows are often only available in monetary units, although information on physical quantities has clear benefits for sustainable resource management. MFAs fill these knowledge gaps and help identify shortfalls, such as inefficiencies in operations, misallocation of useful products into landfill, and risks in resource security for enterprises and urban systems. In addition, accounting material flows lead to unapparent insights, including the material footprint of nations and the notions of treating the built environment as a "mine" or as a carbon sink.

Findings from MFAs may be valuable for a variety of purposes in policymaking, economic planning, and any relevant activities to better coordinating resource management. The European Union, in particular, has embraced MFA as an essential method for monitoring the material sustainability of its member nations. The national statistical institute of each country collects material flow data for an annual questionnaire mandated by Regulation (EU) No. 691/2011. On a local scale, MFA consulting companies such as Metabolic have helped cities including Portland and Copenhagen to determine strategies for improving their circularity.

This course is intended for any student interested in directing resources flows in a more sustainable way, whether it is for industry, policy, or research institutions. In the first section of the course, the readings and lectures will engage students with the foundational ideas, concepts, and methodologies in MFA, leaving students well-versed with the theory. The subsequent weeks will focus on the applications of the tool, exploring how MFA can shed light on many angles of sustainability such as waste management and circular economy, resource efficiency, resource security, planning, and climate change mitigation. This section will incorporate guest speakers and their experiences on how conducting MFAs help decision-making in government and industry. Coursework will include problem sets to build the students' quantitative skills and to familiarize them with the steps of MFAs, as well as to introduce useful resources and data visualization techniques. Students will also carry out a term project that will allow them to gain practical experience with conducting an MFA while investigating a system of their interest. One of the recurring themes throughout the term will be issues with data availability of material accounts. A key skill that students will develop is the ability to find creative approaches to fill those gaps. There are no prerequisites for this course, but basic knowledge of physics and chemistry is recommended.

Learning Objectives

By the end of the course, students should be able to:

L1. Define metrics and indicators used in standard MFA methodologies;
L2. Identify common data gaps in MFA and approaches to address them;
L3. Evaluate and critique whether a presented MFA is plausible;
L4. Conduct an MFA independently and be familiar with reliable data sources;
L5. Propose recommendations for more efficient resource management based on flows and stocks in an MFA;
L6. Plan and conduct a full MFA with recommendations for an enterprise.

Readings

All reading materials will be provided to the students through CourseWorks.

Brunner, P. H., & Rechberger, H. (2004). Introduction. *Practical handbook of material flow analysis* (pp. 1–28). CRC/Lewis.

Chertow, M. R., Graedel, T. E., Kanaoka, K. S., & Park, J. (2020). The Hawaiian Islands: Conceptualizing an Industrial Ecology Holarchic System. *Sustainability*, *12*(8), 3104.

Churkina, G., Organschi, A., Reyer, C. P. O., Ruff, A., Vinke, K., Liu, Z., Reck, B. K., Graedel, T. E., & Schellnhuber, H. J. (2020). Buildings as a global carbon sink. *Nature Sustainability*, *3*(4), 269–276.

Graedel, T. E. (2019). Material Flow Analysis from Origin to Evolution. *Environmental Science & Technology*, *53*(21), 12188–12196.

Graedel, T. E., Harper, E. M., Nassar, N. T., Nuss, P., & Reck, B. K. (2015). Criticality of metals and metalloids. *Proceedings of the National Academy of Sciences*, *112*(14), 4257–4262.

GreenBiz. (2019, July 15). *Metabolic's Eva Gladek: Circular cities in practice: From the Netherlands to North Carolina*. https://www.youtube.com/watch?v=eudGXvllOt8

Johnston, I., Hancock, A., Dempsey, H., & Team, V. S. (2023, September 20). *Can Europe go green without China's critical minerals?* https://ig.ft.com/ig-rare-earths

Kennedy, C., Cuddihy, J., & Engel-Yan, J. (2007). The Changing Metabolism of Cities. *Journal of Industrial Ecology*, *11*(2), 43–59.

Matthews, E., Amann, C., Bringezu, S., Fischer-Kowalski, M., Hüttler, W., Kleijn, R., Moriguchi, Y., Ottke, C., Rodenburg, E., Rogich, D., Schandl, H., Schütz, H., Van Der Voet, E., Weisz, H. (2000). *The weight of nations: Material outflows from industrial economies*. World Resources Institute.

Miatto, A., Dawson, D., Nguyen, P. D., Kanaoka, K. S., & Tanikawa, H. (2021). The urbanisation-environment conflict: Insights from material stock and productivity of transport infrastructure in Hanoi, Vietnam. *Journal of Environmental Management*, *294*, 113007.

Miatto, A., Schandl, H., Forlin, L., Ronzani, F., Borin, P., Giordano, A., & Tanikawa, H. (2019). A spatial analysis of material stock accumulation and demolition waste potential of buildings: A case study of Padua. *Resources, Conservation and Recycling*, *142*, 245–256.

Miatto, A., Wolfram, P., Reck, B. K., & Graedel, T. E. (2021). Uncertain Future of American Lithium: A Perspective until 2050. *Environmental Science & Technology, 55*(23), 16184–16194.

Pauliuk, S., Heeren, N., Berrill, P., Fishman, T., Nistad, A., Tu, Q., Wolfram, P., & Hertwich, E. G. (2021). Global scenarios of resource and emission savings from material efficiency in residential buildings and cars. *Nature Communications, 12*(1), 5097.

Parker, L. (2018, December 20). *A whopping 91% of plastic isn't recycled. National Geographic.* https://www.nationalgeographic.com/science/article/plastic-produced-recycling-waste-ocean-trash-debris-environment

Reck, B. K., & Rotter, V. S. (2012). Comparing Growth Rates of Nickel and Stainless Steel Use in the Early 2000s. *Journal of Industrial Ecology*, *16*(4), 518–528.

Schandl, H., Fischer-Kowalski, M., West, J., Giljum, S., Dittrich, M., Eisenmenger, N., Geschke, A., Lieber, M., Wieland, H., Schaffartzik, A., Krausmann, F., Gierlinger, S., Hosking, K., Lenzen, M., Tanikawa, H., Miatto, A., & Fishman, T. (2018). Global Material Flows and Resource Productivity: Forty Years of Evidence. *Journal of Industrial Ecology*, *22*(4), 827–838.

Soufani, K., & Loch, C. (2021, June 15). *Circular Supply Chains Are More Sustainable. Why Are They So Rare? Harvard Business Review.* https://hbr.org/2021/06/circular-supply-chains-are-more-sustainable-why-are-they-so-rare

Tanikawa, H., Fishman, T., Okuoka, K., & Sugimoto, K. (2015). The Weight of Society Over Time and Space: A Comprehensive Account of the Construction Material Stock of Japan, 1945–2010. *Journal of Industrial Ecology*, *19*(5), 778–791.

van Ewijk, S. & Stegemann, J. (2023). Materials and waste. *An Introduction to Waste Management and Circular Economy* (pp. 2–37). UCL Press.

Wiedmann, T. O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., & Kanemoto, K. (2015). The material footprint of nations. *Proceedings of the National Academy of Sciences*, *112*(20), 6271–6276.

Optional readings:

Baccini, P., & Brunner, P. H. (2023). *Metabolism of the Anthroposphere, second edition: Analysis, Evaluation, Design*. MIT Press.

Cullen, J. M., Allwood, J. M., & Bambach, M. D. (2012). Mapping the Global Flow of Steel: From Steelmaking to End-Use Goods. *Environmental Science & Technology*, *46*(24), 13048–13055.

Eurostat. (2018). *Economy-wide material flow accounts handbook* (pp. 1–142). European Union. https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-18-006

Fischer-Kowalski, M., F. Krausmann, S. Giljum, S. Lutter, A. Mayer, S. Bringezu, Y. Moriguichi, H. Schütz, H. Schandl, and H. Weisz. 2011. Methodology and Indicators of Economy-wide Material Flow Accounting. *Journal of Industrial Ecology 15*(6): 855–876.

Fishman, T., & Graedel, T. E. (2019). Impact of the establishment of US offshore wind power on neodymium flows. *Nature Sustainability*, *2*(4), 332-338.

Müller, E., Hilty, L. M., Widmer, R., Schluep, M., & Faulstich, M. (2014). Modeling Metal Stocks and Flows: A Review of Dynamic Material Flow Analysis Methods. *Environmental Science & Technology*, *48*(4), 2102–2113.

Pauliuk, S., & Heeren, N. (2020). ODYM—An open software framework for studying dynamic material systems: Principles, implementation, and data structures. *Journal of Industrial Ecology*, *24*(3), 446–458.

Peled, Y., & Fishman, T. (2021). Estimation and mapping of the material stocks of buildings of Europe: A novel nighttime lights-based approach. *Resources, Conservation and Recycling*, *169*, 105509.

van Ewijk, S., Stegemann, J. A., & Ekins, P. (2018). Global Life Cycle Paper Flows, Recycling Metrics, and Material Efficiency. *Journal of Industrial Ecology*, *22*(4), 686–693.

Assignments and Assessments

Reading notes (Target learning objectives: L1, L3)

Students are asked to submit a total of 10 "reading notes" across the first 11 class sessions (i.e., one free pass for a session of the student's choice). Reading notes should consist of one (or more, if you wish) question you have for each assigned reading and a paragraph with your justification/logic behind each question. The notes are meant to be brief, and submissions should not exceed 500 words. Please feel welcome to discuss the questions during class, and the instructor may also refer to the questions to stimulate class discussion. This task is intended for improving your engagement with the course material. Submissions will be evaluated considering the quality of questions and justifications. Submissions with less than 250 words may be penalized, as they often have inadequate explanations. Reading notes are due by 2:00pm on the day of class sessions.

Blog post- policy/business recommendation (L3, L5)

During the term (from week 2 onward), students are asked to each post a total of one blog on *CourseWorks* that critically assess an MFA study of their choice and provide recommendations for decisionmakers (business, government, or others). The blog post should be ~750–1,000 words depending on the topic and your argument; shorter posts often have insufficient analysis and may be penalized. Each post should briefly summarize the MFA study, critique its soundness (e.g., quality of data sources), and advance your own recommendations based on the analysis for relevant stakeholders to improve their sustainability. You should use and cite external references where appropriate. The posts will be evaluated based on their clarity, insight, creativity, persuasiveness, and quality of writing.

Other students are encouraged to post reactions and engage with the material online. This mode of discourse provides less vocal students with opportunities to still participate in class discourse. The blog post will be due on the day before class sessions by 5:00pm. There will be limited spots for each due date, and a signup sheet will be available online. More detailed instructions on the content of the blog post will be available on *CourseWorks.*

Problem sets (L1, L4)

Students will be assigned a total of three problem sets throughout the semester, reviewing foundational concepts and tools for conducting MFAs. The problem sets will be due on Thursday of weeks 2, 3, and 4, each with a dedicated lab time on Thursday of the preceding week. The content of the assignments builds on the previous one and will increase in complexity, from simple mass-balances to using the economy-wide and multi-regional MFA frameworks. All problem sets will use MS Excel for calculations, accompanied with a Word file submission with a brief, narrative description of your work process.

Problem sets will be assessed based on the correctness of the responses, soundness of the taken approach, and appropriate use of visualizations.

Mid-term quiz (L1, L2, L4)

There will be one mid-term evaluation intended for re-emphasizing the key concepts for conducting MFAs. All necessary knowledge for the evaluation will be covered in lectures. The evaluation is best described as a "quiz" and will last one hour. The quiz will be open book and will require you to solve simple problems using the MFA approach. This evaluation style is preferred over stressful and formal mid-term and final exams, as it better simulates real-world situations. The quiz will be evaluated based on the student's familiarity with the course material, ability to apply course material to practical situations, and the soundness of logic and approach.

Group term project (L1, L2, L4, L5, L6)

The course includes a term project for you to gain hands on experience conducting a full MFA. You are welcome to choose a topic of your choice but must forms groups analyzing the same topic. The group sizes will depend on the enrollment of the class. Project topics may include an economy-wide MFA for a town or a country, a substance flow analysis for a metal, and projections of building stocks. These are just ideas, and the final project topic should be determined with guidance from the instructor. To aid with a successful completion of the project, the process will include multiple checkpoints to ensure ample opportunities for feedback. The project grade is divided over four components and deliverables:

1) a one-page proposal/work plan with references (Thursday, July 11th);
2) a full report outline with references (Tuesday, July 23rd);
3) an oral presentation given in class (in the final class session, Thursday, August 8th);
4) the final report including a one-page executive summary and MS excel file by August TBD at 5pm.

In addition, each group will have an opportunity to briefly share their project ideas and receive feedback from peers during the class session on Thursday, July 18th. Please feel free to reach out to me regarding your project ideas any time.

The final product will take the form of a carefully prepared 15–18 slide Powerpoint presentation (or equivalent) plus thorough notes pages and references. Alternatively, the group may submit a 15–18-page, double-spaced paper, memo, or analysis. Students can select the format that appears most practical for the organization to which they are assigned. A completed project also includes an anonymous team member evaluation. The proposal and outline will be graded based on completeness and effort. The oral presentation will be assessed based on flow, clarity, quality of slides, and the content. The evaluation of the final deliverable will consider the effectiveness of the executive summary, strength of analysis, quality of writing, and insight of recommendations.

Grading

The final grade will be calculated as described below:

FINAL GRADING SCALE

Grade	Percentage
A+	98–100 %
A	93–97.9 %
A-	90–92.9 %
B+	87–89.9 %
B	83–86.9 %
B-	80–82.9 %
C+	77–79.9 %
C	73–76.9 %
C-	70–72.9 %
D	60–69.9 %
F	59.9% and below

Assignment/Assessment	% Weight	Individual or Group/Team Grade
Participation and reading notes	10	Individual
Problem sets (3 sets, 8% each)	24	Individual
Blog post- policy/business recommendation	6	Individual
Midterm quiz	10	Individual
Term project (50 total)		
Proposal	5	Group
Full outline	10	Group
Presentation	15	Group
Final Deliverable	20	Group

Course Schedule/Course Calendar

*Disclaimer: Guest speakers are tentative, and speakers/dates may change based on their availability

Date	Topics and Activities	Readings (due on this day)	Assignments (due on this date)
Session 1 7/2 (Tue)	**Foundations** Course overview (Introduction to MFA and syllabus) Activity: Material flow accounting of your metabolism	Brunner & Rechberger (2004). *Practical handbook of material flow analysis*. Introduction. *(28 pages)* Graedel (2019). Material Flow Analysis from Origin to Evolution. *(9 pages)*	Reading Note #1 Due

Session 2 7/4 (Thu)	**Foundations**: Terminologies, concepts, and basic methods Economy-wide MFA and the Eurostat guide Lab time: Methods training #1 (including Sankey diagrams) and introduction to Problem set #1	Matthews et al. (2000). *The weight of nations. (pp. XI to 41; 43 pages)* **Optional:** Eurostat. (2018). Economy-wide material flow accounts. *(142 pages)*	Reading Note #2 Due
Session 3 7/9 (Tue)	**Foundations** Multi-regional input output (MRIO) methods, dynamic MFA, and indicators Lab time: Methods training #2 (tutorial of tools- EXIOBASE, EORA, etc.)	Schandl et al. (2018). Global Material Flows and Resource Productivity. *(12 pages)* Wiedmann et al. (2015). The material footprint of nations. *(6 pages)* **Optional:** Fischer-Kowalski (2011). Methodology and Indicators of Economy-wide Material Flow Accounting. *(22 pages)*	Reading Note #3 Due
Session 4 7/11 (Thu)	**Foundations** Substance flow analysis, methodological challenges, and assumptions Lab time: Methods training #3 and introduction to Problem set #2	Parker (2018). *A whopping 91% of plastic isn't recycled. (4 pages)* Reck & Rotter (2012). Comparing Growth Rates of Nickel and Stainless Steel Use in the Early 2000s. *(11 pages)* **Optional:** Cullen et al. (2012). Mapping the Global Flow of Steel. *(8 pages)* van Ewijk et al. (2018). Global Life Cycle Paper Flows, Recycling Metrics, and Material Efficiency. *(8 pages)*	Reading Note #4 Due Problem Set #1 Due Project Proposal Due
Session 5 7/16 (Tue)	**Foundations** Urban metabolism, Islands MFA *Midterm Quiz*	Chertow et al. (2020). The Hawaiian Islands. *(17 pages)* Kennedy et al. (2007). The Changing Metabolism of Cities. *(17 pages)*	Reading Note #5 Due
Session 6 7/18 (Thu)	**Applications** Criticality	Graedel et al. (2015). Criticality of metals and metalloids. *(6 pages)*	Reading Note #6 Due Problem Set #2 Due

	Speed round presentation of project topics and feedback Lab time: Introduction to Problem set #3	Johnston et al. (2023). *Can Europe go green without China's critical minerals?* (*Interactive website*) **Optional:** Fishman & Graedel (2019). Impact of the establishment of US offshore wind power on neodymium flows. *(7 pages)*	
Session 7 7/23 (Tues)	**Applications** Waste management and circular economy *Guest speaker:* Alessio Miatto Lab-time: Term project and meet with instructor	Soufani & Loch (2021). *Circular Supply Chains Are More Sustainable. Why Are They So Rare? (7 pages)* van Ewijk & Stegemann (2023). *An Introduction to Waste Management and Circular Economy.* Materials and waste. *(37 pages)* **Optional:** Miatto et al. (2019). A spatial analysis of material stock accumulation and demolition waste potential of buildings. *(12 pages)*	Reading Note #7 Due Project Outline Due
Session 8 7/25 (Thu)	**Applications** Built environment, advanced methods (GIS, remote sensing, etc.) Lab time: Methods training #5 (including visualizing MFA results)	Churkina et al. (2020). Buildings as a global carbon sink. *(8 pages)* Tanikawa et al. (2015). The Weight of Society Over Time and Space. *(14 pages)* **Optional:** Müller et al. (2014). Modeling Metal Stocks and Flows. *(12 pages)* Peled & Fishman (2021). Estimation and mapping of the material stocks of buildings of Europe. *(11 pages)*	Reading Note #8 Due Problem Set #3 Due
Session 9 7/30 (Tue)	**Applications** MFA consulting: Metabolic, Amsterdam; socio-economic research *Guest Speaker TBD*	GreenBiz. (2019). Metabolic's Eva Gladek: Circular cities in practice. *(13 min video)* TBD	Reading Note #9 Due
Session 10 8/1 (Thu)	**Applications** MFA and policymaking, part 1	Miatto et al. (2021). The urbanisation-environment conflict. *(12 pages)*	Reading Note #10 Due

	Guest Speaker: Etienne Berthet	TBD	
Session 11 8/6 (Tue)	**Applications** MFA and policymaking, part 2: Scenario analysis Lab time: Term project group work	Miatto et al. (2021). Uncertain Future of American Lithium. *(11 pages)* Pauliuk et al. (2021). Global scenarios of resource and emission savings from material efficiency in residential buildings and cars. *(10 pages)* **Optional:** Pauliuk & Heeren (2020). ODYM—An open software framework for studying dynamic material systems. *(13 pages)*	Reading Note #11 Due
Session 12 8/8 (Thu)	**Concluding session** Term project presentations & final remarks		Term Projects Slides Due
TBD			Term Projects Due

Course Policies

Participation and Attendance
Students are expected to attend and engage in each session. For each session, students should come to the class prepared with a short list of questions (see Assignments and Assessments above) and with insights to share with others. Quality of comments is more important than quantity. I look forward to an interesting and lively discussion.

Late work
Work that is not submitted on the due date noted in the course syllabus without advance notice and permission from the instructor will be graded down 1/3 of a grade for every day it is late (e.g., from a B+ to a B).

Citation & Submission
All written assignments must use standard citation format (e.g., MLA, APA, Chicago), cite sources, and be submitted to the course website (not via email).

School and University Policies and Resources

Copyright Policy
Please note—Due to copyright restrictions, online access to this material is limited to instructors and students currently registered for this course. Please be advised that by clicking the link to the electronic materials in this course, you have read and accept the following:

> The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

Academic Integrity
Columbia University expects its students to act with honesty and propriety at all times and to respect the rights of others. It is fundamental University policy that academic dishonesty in any guise or personal conduct of any sort that disrupts the life of the University or denigrates or endangers members of the University community is unacceptable and will be dealt with severely. It is essential to the academic integrity and vitality of this community that individuals do their own work and properly acknowledge the circumstances, ideas, sources, and assistance upon which that work is based. Academic honesty in class assignments and exams is expected of all students at all times.

SPS holds each member of its community responsible for understanding and abiding by the SPS Academic Integrity and Community Standards posted at https://sps.columbia.edu/students/student-support/academic-integrity-community-standards. You are required to read these standards within the first few days of class. Ignorance of the School's policy concerning academic dishonesty shall not be a defense in any disciplinary proceedings.

Diversity Statement
It is our intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture.

Accessibility
Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process. For more information regarding this service, please visit the University's Health Services website: https://health.columbia.edu/content/disability-services.

Class Recordings
All or portions of the class may be recorded at the discretion of the Instructor to support your learning. At any point, the Instructor has the right to discontinue the recording if it is deemed to be obstructive to the learning process.

If the recording is posted, it is confidential and it is prohibited to share the recording outside of the class.

SPS Academic Resources
The Division of Student Affairs provides students with academic counseling and support services such as online tutoring and career coaching: https://sps.columbia.edu/students/student-support/student-support-resources.

Columbia University Information Technology
Columbia University Information Technology (CUIT) provides Columbia University students, faculty and staff with central computing and communications services. Students, faculty and staff may access University-provided and discounted software downloads.

Columbia University Library
Columbia's extensive library system ranks in the top five academic libraries in the nation, with many of its services and resources available online.

The Writing Center
The Writing Center provides writing support to undergraduate and graduate students through one-on-one consultations and workshops. They provide support at every stage of your writing, from brainstorming to final drafts. If you would like writing support, please visit the following site to learn about services offered and steps for scheduling an appointment. This resource is open to Columbia graduate students at no additional charge. Visit http://www.college.columbia.edu/core/uwp/writing-center.

Career Design Lab
The Career Design Lab supports current students and alumni with individualized career coaching including career assessment, resume & cover letter writing, agile internship job search strategy, personal branding, interview skills, career transitions, salary negotiations, and much more. Wherever you are in your career journey, the Career Design Lab team is here to support you. Link to https://careerdesignlab.sps.columbia.edu/

Netiquette is a way of defining professionalism for collaborations and communication that take place in online environments. Here are some Student Guidelines for this class:

- Avoid using offensive language or language that is not appropriate for a professional setting.
- Do not criticize or mock someone's abilities or skills.
- Communicate in a way that is clear, accurate and easy for others to understand.
- Balance collegiality with academic honesty.
- Keep an open-mind and be willing to express your opinion.
- Reflect on your statements and how they might impact others.
- Do not hesitate to ask for feedback.
- When in doubt, always check with your instructor for clarification.