

Reaction	Representative Traditional Procedures (Highlighted procedure is used in evaluation)	Greener Options (Highlighted procedure is used in evaluation)
Grignard Reaction	Grignard Synthesis of Benzoic Acid, K. L. Williamson, <i>Macroscale and Microscale Organic Experiments</i> , 2nd Ed. 1994, Houghton Mifflin, Boston, p. 364.	Water-Soluble Catalysis: Aqueous Analogue of the Grignard Reaction, Warner, J.C., in <i>Greener Approaches to Undergraduate Chemistry Experiments</i> , American Chemical Society, 1999, 23-24.
	Phenylmagnesium bromide (phenyl Grignard reagent), Benzoic acid preparation and Triphenylmethanol preparation procedures, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 495-505.	A Grignard-like Organic Reaction in Water, <i>J. Chem. Educ.</i> 1998, 75, 85.
		Microwave-Assisted Carbonyl Chemistry for the Undergraduate Chemistry Laboratory, <i>J. Chem. Educ.</i> 2009, 86, 227-229
Esterification	Fischer Esterification, <i>Organic Chemistry Laboratory Manual</i> , A. B. Pafas, Hayden-McNeil, 2013	Acid-Catalyzed Preparation of Biodiesel from Waste Vegetable Oil: An Experiment for the Undergraduate Organic Chemistry Laboratory, <i>J. Chem. Educ.</i> 2011, 88, 201-203
	Methyl benzoate by Fischer Esterification, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 524-525.	Replacing Mineral Acids in the Laboratory: Nafion-Catalyzed Dehydration and Esterification, <i>J. Chem. Educ.</i> 1993, 70, 493-495
		Preparation of Benzyl Acetate from Acetic Anhydride, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, 2011, pp. 523.
Aldol Condensation	Preparation of trans-p-Anisalacetophenone, <i>Experimental Organic chemistry</i> , 2011, 5th Edition, Gilbert and Martin, p. 620.	Solventless Reactions: The Aldol Reaction, <i>Green Organic Chemistry – Strategies, Tools, and Laboratory Experiments</i> , Doxsee, K.M. And Hutchison, J.E., Tompson Brooks/Cole, 2004, pp. 115-119
		Solvent-free Synthesis of Chalcones, <i>J. Chem. Educ.</i> , 2004, 81, 1345
		Green Chemistry Laboratory: Benign Synthesis of 4,6-Diphenyl[2,2']bipyridine via Sequential Solventless Aldol and Michael Additions, <i>J. Chem. Educ.</i> 2005, 82, 468-469
		A Green Enantioselective Aldol Condensation for the Undergraduate Organic Laboratory, <i>J. Chem. Educ.</i> 2006, 83, 1871-1872
		The Aldol Addition and Condensation: The Effect of Conditions on the Reaction Pathway, <i>J. Chem. Educ.</i> 2007, 84, 475-476
Benzoin Condensation	Cyanide-Catalyzed Benzoin Condensation, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 655-658.	Thiamine-Catalyzed Benzoin Condensation, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 659-660.
Dehydration of an Alcohol - Zaitsev Elimination	Dehydration of cyclohexanol to cyclohexene with phosphoric acid, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 335-357.	Alternative Greener Method for Preparation of Alkenes from Alcohol, http://www.cs.gordon.edu/courses/organic/salem/Montmorillonite-alkene.pdf
		Synthesis and Spectroscopic Analysis of a Cyclic Acetal: A Dehydration Performed in Aqueous Solution, <i>J. Chem. Educ.</i> , 2001, 78 (1), p 70
Elimination: Dehydrohalogenation	Dehydrobromination of Meso-Stilbene Dibromide, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, 2011, pp. 405-409	Green Synthesis of a Fluorescent Natural Product, <i>J. Chem. Educ.</i> , 2011, 88 (3), pp 319-32
		Pedagogical Comparison of Five Reactions Performed under Microwave Heating in Multi-Mode versus Mono-Mode Ovens: Diels-Alder Cycloaddition, Wittig Salt Formation, E2 Dehydrohalogenation To Form an Alkyne, Williamson Ether Synthesis, and Fischer Esterification, <i>J. Chem. Educ.</i> , 2014, 91 (10), pp 1720-1724
Bromination	Bromination of (E)-Stilbene, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, 2011, pp. 377	Bromination of (E)-Stilbene: The Green Approach, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, 2011, pp. 378
		Chitra Chandrasekhar & Veljko Dragojlovic (2010) Reaction of bromine with 4,5-dimethyl-1,4-cyclohexadiene-1,2-dicarboxylic acid: a green chemistry puzzle for organic chemistry students, <i>Green Chemistry Letters and Reviews</i> , 3:1, 39-47.
		Bromination of aromatics with pyridinium hydrobromide perbromide: an organic laboratory experiment, <i>Chem. Educ.</i> 1998, 3(2)
Electrophilic Aromatic Substitution	Nitration of Bromobenzene, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, p. 515	The Evolution of a Green Chemistry Laboratory Experiment: Greener Brominations of Stilbene, <i>J. Chem. Educ.</i> , 2005, 82 (2), p 306
		A Green, Guided-Inquiry Based Electrophilic Aromatic Substitution for the Organic Chemistry Laboratory, Eby, E. and Deal, S. T., <i>Green Chemistry</i> , 2008, 85, 1426-1428
Friedel-Crafts Alkylation	Friedel-Crafts Alkylation of p-xylene, <i>Experimental Organic Chemistry</i> , Gilbert & Martin, 5th edition, 2011, p. 495-496.	A simple and practical halogenation of activated arenes using potassium halide and oxone in water-acetonitrile medium, <i>Synth. Comm.</i> 2001, 31 (13), 2021-2027
		A Greener Alternative to Aluminum Chloride Alkylation of Xylene, Sereda, G.A. And Rajpara, V.B., <i>J. Chem. Ed.</i> , 2007, 84(4), 692
Friedel-Crafts Acylation	Friedel-Crafts Acylation of m-Xylene with Phthalic Anhydride, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, 2011, p. 505-506.	A Research-Based Undergraduate Organic Laboratory Project: Investigation of a One-Pot, Multicomponent, Environmentally Friendly Prins-Friedel-Crafts-Type Reaction, <i>J. Chem. Educ.</i> 2012, 89, 265-267
		Introducing environmentally benign synthesis into the introductory organic lab - a greener Friedel-Crafts acylation, <i>The Chemical Educator</i> , 2001, 6(1), 25-27
		A Research-Based Undergraduate Organic Laboratory Project: Investigation of a One-Pot, Multicomponent, Environmentally Friendly Prins-Friedel-Crafts-Type Reaction, <i>J. Chem. Educ.</i> 2012, 89, 265-267
Oxidation	The Oxidation of a Ketone to a Carboxylic Acid: Cyclohexanone from Cyclohexanol, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 358-359.	A Microwave-Assisted Friedel-Crafts Acylation of Toluene with Anhydrides, <i>J. Chem. Educ.</i> , 2013, 90 (3), pp 390-392
		Guo, Ming-Lin; Li, Hui-Zhen Li. Selective oxidation of benzyl alcohol to benzaldehyde with hydrogen peroxide over tetraalkylpyridinium octamolybdate catalysts. <i>Green Chem.</i> 2007, 9, 421-423.
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		Oxidation of Aromatic Aldehydes Using Oxone, <i>J. Chem. Educ.</i> , 2007, 84 (5), p 852 (aldehyde-acid)
	Environmentally Responsible Redox Chemistry: An Example of Convenient Oxidation Methodology without Chromium Waste, <i>J. Chem. Educ.</i> , 2006, 83 (2), p 268 (alcohol oxidation)	
	pH-Controlled Oxidation of an Aromatic Ketone: Structural Elucidation of the Products of Two Green Chemical Reactions, <i>J. Chem. Educ.</i> , 2010, 87 (2), pp 190-193 (ketone oxidation)	

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Reduction	Reduction of 9-Fluorenone, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th edition, 2011, 582	Enantioselective Reduction by Crude Plant Parts: Reduction of Benzofuran-2-yl Methyl Ketone with Carrot (<i>Daucus carota</i>) Bits, <i>J. Chem. Ed.</i> , 2006, 83 (7), 1049
		Synthesis of Methyl Diantilis, a Commercially Important Fragrance, <i>J. Chem. Educ.</i> 2006, 83, 285–286 (aldehyde reduction)
		Green Chemical Experiment: Indigo Dyeing, <i>Chem. Educ.</i> 2008, 13(6), 344–347 (ketone reduction)
Diels-Alder	Reaction of 1,3-cyclopentadiene and maleic anhydride, <i>Experimental Organic Chemistry</i> , 5th Edition, Gilbert and Martin, 2011, p. 429-430	Greener Solutions for the Organic Chemistry Teaching Lab: Exploring the Advantages of Alternative Reaction Media, McKenzie, L.C., Huffman, L.M., Hutchison, J.E., Rogers, C.E., Goodwin, T.E., Spessard, G.O., <i>J. Chem. Educ.</i> 2009, 86, 488–493
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Wittig	Synthesis of trans-9-(2-phenylethenyl) anthracene (microscale), <i>Macroscale and Microscale Organic Experiments</i> , 6e; Brooks/Cole, 2011; pp. 509-510	Solvent-Free Wittig Reaction: A Green Organic Chemistry Laboratory Experiment, Leung, S. H., Angel, S. A., <i>J. Chem. Educ.</i> , 2004, 81 (10), p 1492
		Solvent-Free Synthesis and Fluorescence of a Thiol-Responsive Sensor for Undergraduate Organic Laboratories, <i>J. Chem. Educ.</i> , 2013, 90 (12), pp 1685–1687
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		Greening Wittig Reactions: Solvent-Free Synthesis of Ethyl trans-Cinnamate and trans-3-(9-Anthryl)-2-Propenoic Acid Ethyl Ester, <i>J. Chem. Educ.</i> , 2007, 84 (1), p 119
SN2 and SN1 Reactions	Preparation of 1-bromobutane: An SN2 Reaction, <i>Experimental Organic Chemistry</i> , Gilbert and Martin, 5th Edition, 2011, p. 465-466 (Miniscale Procedure)	A Simple SN2 Reaction for the Undergraduate Organic Laboratory, <i>J. Chem. Educ.</i> 2009, 86, 850
	Synthesis of 2,5-Dichloro-2,5-dimethylhexane by an SN1 Reaction, Wagner, C.E., Marshall, P.A., <i>J. Chem. Ed.</i> , 87(1), 2010, 81-83	
Polymers	Synthesis of nylon by interfacial polymerization, <i>Macroscale and Microscale Organic Experiments</i> , 6e; Brooks/Cole, 2011; pp. 763-765	A Green Polymerization of Aspartic Acid for the Undergraduate Organic Laboratory, <i>J. Chem. Educ.</i> , 2005, 82, 1380–1381
		Ring-Opening Polymerization of Lactide To Form a Biodegradable Polymer, <i>J. Chem. Educ.</i> 2008, 85, 258–260 (polylactic acid)
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Metal Cross-Coupling Reactions		Sustainable Polymers in the Organic Chemistry Laboratory: Synthesis and Characterization of a Renewable Polymer from δ -Decalactone and L-Lactide, <i>J. Chem. Educ.</i> 2014, 91, p. 131-135 (renewable triblock copolymers)
		An Operationally Simple Aqueous Suzuki-Miyaura Cross-Coupling Reaction for an Undergraduate Organic Chemistry Laboratory, Hamilton, A. E., Buxton, A. M., Peeples, C. J., Chalker, J. M., <i>J. Chem. Ed.</i> , 2013, 90, 1509-1513.
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Chemiluminescence	Synthesis of Luminol, <i>Macroscale and Microscale Organic Experiments</i> , Brooks/Cole, 6th Edition, 2011, p. 708-709 (1-9 are for the synthesis, 10-13 are for the light-producing reaction)	A Greener Chemiluminescence Demonstration, <i>J. Chem. Ed.</i> , 2011, 88(6), pp. 786-787 (1-8 are for the synthesis, 9-11 are for the light-producing reaction)
Technique		
Column chromatography		A Green Approach To Separate Spinach Pigments by Column Chromatography, McDougal, O.M., et. al., <i>J. Chem. Educ.</i> , 2013, 90 (6), pp 796–798
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Simple Distillation	Simple Distillation of a Cyclohexane-Toluene Mixture, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 92-93.	Simple Distillation: Purification and Reuse of Acetone, Lecher, C.S., Marian College, Greener Educational Materials for Chemists, 2007 [http://greenchem.uoregon.edu/PDFs/GEMsID91.pdf , Accessed February 2017]
	Simple Distillation of an Ethanol-Water Mixture, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 93-94.	
Fractional Distillation	Simple Distillation of a Cyclohexane-Toluene Mixture, <i>Macroscale and Microscale Organic Experiments</i> , Williamson, K.L., Masters, K.M., 6th Edition, Brooks/Cole Cengage Learning, 2011, pp. 94-95.	Recycling of Waste Acetone by Fractional Distillation, McDougal, O.M., et. al., <i>J. Chem. Educ.</i> , 2011, 88 (12), pp 1724–1726
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Extraction		Green Soap: An Extraction and Saponification of Avocado Oil, Sutheimer, S., Caster, J. M., Smith, S. H., <i>J. Chem. Ed.</i> , 2015, 92, 1763-1765.