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理工专业通用学术英语

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内 容 简 介

《理工专业通用学术英语•提升篇》主要培养学生的语篇能力和思辨能力。阅读材料为能源、交通、宇航、自动化、环境、气候变化、基因工程、身心健康等学科的通俗化学术文章，内容前沿，信息量大。文章结构复杂，但脉络清晰，构思严谨，文笔流畅，具有重要语篇教学价值。每个单元的阅读材料和听力材料的主题相关，先读后听，有利于对听力材料的理解。教学活动和练习设计从分析语篇层面的功能基调、交际目的、信息结构和修辞策略入手，围绕理解、提炼、分析、利用信息的技能培养而展开，提高理解与产出的互动强度，将思辨能力和语言产出能力培养融为一体。

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北京理工大学出版社助力疫期在线教学

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前　言

一、教材建设项目背景

《理工专业通用学术英语》分为基础篇、提升篇、拓展篇、应用篇四个分册，是北京理工大学近年来为了实现建设国内一流、国际知名高水平研究型大学战略目标所采取的课程体系改革措施的重要组成部分。自“十二五”以来，我校把扩大国际交流与合作，实现人才培养的国际化作为推进学校教育事业发展的战略举措。通过国际化高端引智计划和校内引智基地，学校国际交流项目增加到 109 个，参加国际交流活动的学生逐年稳步增长。到 2014 年为止，本科生参加国际交流活动的学生比例达 20%以上，国际化办学蓬勃发展。

2011 年以来，学校借鉴国际一流大学的办学模式，建设了电子科学与技术、机械工程、自动化和国际经济与贸易等 4 个本科全英文教学专业和 15 个研究生全英文授课学科点，开设了全英语/双语本科专业课程 110 门、研究生专业课程 83 门，聘请专业类外籍教师从事教学和科研工作，对学生的英语能力要求明显提高。但在原本科生教学计划内，学生完成大学英语的 16 学分之后，对英语/双语课程学习依然存在一定的语言障碍，无论是阅读专业文献，还是听课、用英语完成作业都比较吃力。一些学院和学生因此质疑大学英语教学效率，呼吁减少大学英语课程，将大学英语学分学时用于本学院开设的口语、科技英语、学术写作等课程上，这些呼吁使大学英语教师惶恐不安。

2013 年年初，学校为了落实教育部《国家中长期教育改革和发展规划纲要（2010—2020）》的文件精神，根据“德以明理，学以精工”的校训，创立了以培养拔尖创新人才为目标的“明精计划”，同时设立了“徐特立英才班”，采用本、硕、博贯通培养模式，大学英语、研究生英语教学各自为政的教学管理模式和思维定式与学校人才培养模式之间的矛盾已无法回避。

经过全面和周密的需求分析与多次课程论证后，学校决定冲破大学英语和研究生英语的藩篱，将目前硕士、博士研究生的英语教学内容整合到本科生英语课程中，并将本科生的英语课程定位为通用学术英语，共 16 学分，256 学时，分四个学期完成，取代大学英语。在完成 16 学分后，与全英文/双语课程实现无缝对接。这一举措将满足学生的个性化发展需求，学生可以根据自己的英语基础和学业发展目标，在大一、大二修完 16 学分的通用学术英语课程，具备学术英语交流的基本能力，继而在本科高年级和研究生阶段选修全英文/双语专业课程，研读专业文献，直接把英语当作学习和研究的工具，免去了硕士、博士研究生期间的英语必修学位课。校长胡海岩院士亲自批示了通用学术英语课程建设论证报告，将该课程纳入“明精计划”重点建设课程之一。于是，该课程被

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赋予了为提升学校的国际知名度、影响力和竞争力提供坚实语言支撑的历史使命。本套教材是该课程建设的配套建设项目。

二、教材建设思路

1. 与学校的强势专业紧密结合，与全英文/双语课程无缝对接

本套教材与通用学术英语课程建设完全配套，与学校的重点专业紧密结合。通用学术英语是通用英语与专业英语的桥梁，既培养学生用英语进行专业领域或相关领域的学习能力，又培养学生把英语作为工具进行科学研究和国际交流的能力，即对学术语篇的理解与产出的能力。学术语篇指各专业领域在知识创造和传播过程中所产出的用以承载知识和信息的口头和书面语篇类型，如教科书、专著、研究论文、科技报告、科普文章、书评、学术讲座、学术讨论、课程作业等。那么，通用学术英语的教学目的首先是培养学生理解这些语篇的能力。

教材是实现教学目标的重要手段，教学材料的价值在于它是特定学习者需要掌握的典型的学术语篇类型，以及学习者理解和构建这些学术语篇类型需要掌握的语言各层面的知识和技能。本套教材的选材与学校专业特色相结合，材料中的知识内容包括电子、信息、机械、交通、车辆、宇航、自动化、化工、材料等专业。无论是知识内容还是表达形式都有利于与这些专业院系的全英文/双语课程对接。表达形式指这些领域中学术语篇的主要类型、构建方法、篇章、句子、词汇、表达特征等。了解这些特征既有助于提高学生的理解能力和阅读速度，也有助于提高其写作能力。

2. 尊重学生成长特征，合理分解各分册教学目标

学生经过中小学 10 年以上的英语学习经历，形成并习惯了适合基础英语学习阶段所采用的教学、学习理念，教学材料和教学方法。因此，本套教材基础篇的首要任务是使学生在英语学习目的、内容、方法、策略等关键问题上实现从通用英语到通用学术英语的根本转变，使学生逐步适应以传播知识和信息为交际目的的真实语篇，适应科技新闻报道中的正常语速，扩充大量通用学术词汇和半技术词汇。在自主学习能力培养方面，通过大量具有讨论价值的话题和材料阅读，使学生认识到英语是获取知识和信息、交流思想、拓宽视野、增长智慧的重要工具，以培养学生对英语学习的持久兴趣，将外驱动力转化为内生动力，发挥主观能动性，使学习成为自觉行为。在以后的三个学期中，循序渐进地实施英语语篇层面深度知识和技能培养的教学（见表 1），使每一阶段的练习和每项活动都成为通向宏观教学目标的阶石。

表 1　各分册教学目标

基础篇	使学生在英语学习目的、内容、方法、策略等关键问题上实现从中学的通用英语到通用学术英语的根本转变，从被动的语言学习者变为主动的语言学习和语言使用者，在语言使用中持续发展语言能力。 重视听、说、读、写基本功训练，使学生逐步适应真实的书面和口头语篇特征，适应听力材料中的正常语速、英国英语和美国英语的语音差异。

续表

基础篇	通过大量真实的书面和口头语料输入，扩充普通词汇量和通用学术词汇量，并为学生打开新的知识窗口，培养学生用英语获取信息、知识和各学科最新科研成果的兴趣，享受用英语讨论最新科技信息的乐趣。在语言能力培养中注入学术素养元素，培养优秀科技工作者所具备的优秀品质和人格特征
提升篇	通过加大真实语料的输入和阅读方法的训练，克服阅读英语原版长文章的恐惧心理，使学生的语篇能力和语言能力得到快速和显著提升。 训练学生阅读热门科技领域通俗化原版科技文章的方法，快速识别文章的功能基调及相应的语篇类型，熟悉语篇的宏观组织结构（如问题—解答、总括—具体、问题—原因—解决方案、假设—验证、论点—论据）和修辞策略（如叙述、解释、举例、比较、对照、分类等），理解作者的观点、目的与主要细节。同时了解科技词汇的特征，掌握扩大词汇量的方法和策略，大量扩充通用词汇和半科技词汇。 利用与阅读材料主题相关的听力材料，使学生逐步适应较长篇幅的报道、讲话或访谈，理解说话者的主旨、态度和重要细节。 培养学生批判性阅读能力、语篇逻辑能力和语篇组织能力，对阅读和听到的内容进行提炼、总结、分析、评价，使语言产出能力有显著提高
拓展篇	实现从通俗化学术语篇向更加专业学术语篇过渡和拓展，使学生具备理解英语原版教材、专著、咨询报告、讲座的能力。通过阅读和分析英语原版教材章节和专著章节，熟悉理工专业文献中的语言共核成分、语篇结构模式和语篇构建方法，从而提高阅读英语原版著作的速度和准确性。 培养学生的英语语体意识和语体敏感性，了解访谈、讲座、学术报告、学术讨论等常用口头学术语篇的特征，借助语体特征提高理解能力。 培养学生语言运用的精确性，经准备能用准确、得体的语言书面或口头概括教材章节的主要内容，解释本专业的关键概念，并通过互相提问、质疑、讨论，培养交际中的社会语言能力和语用能力
应用篇	实现从语体能力培养到学术语类能力培养的过渡。了解文献综述报告、研究计划、立项申请报告、实验报告、学术论文等主要学术语类的共性与特性，各自的功能基调和人际基调，熟悉并运用这些语类在宏观和微观层面上的语言特征，提高阅读理解的效率和准确性。 培养学生听懂较长篇幅报告、访谈的能力，并提炼、总结其要点。 将所学的知识和技能用于专业文献阅读和写作中，具备撰写文献综述报告、立项申请报告、实验报告、学术论文等主要语类的基本能力。结合自己的科研领域撰写上述文献，并将所写的书面文献改为口头语体加以陈述和展示

3. 根据语篇类型特征，优化设计各分册教学材料

学术语篇体系极其复杂。从话语范围看，包括自然科学和社会科学的各个领域，每个领域有多分支、多交叉等特点。根据话语的功能基调，学术语篇具有不同的宏观交际目的，如论证观点、传递信息、传授知识、报告事实、发表评论等。根据人际基调，学术语篇具有不同程度的正式性和专业性。在知识和信息交流中，话语参与者的角色特点和专业背景知识不同，作者/说者会根据自己的交际目的、交际场合和读者/听者的角色特征和专业背景选择技术程度不同的交际内容和表达方式。

综合考虑学生的年龄特征和专业背景，本套教材的选材主要考虑三个因素：语言难

度、语篇形式的规范化和正式性程度、内容的专业程度（见图 1）。基础篇语言难度最低，写作形式最灵活，相对正式程度较低，内容最通俗。

从交际活动参与者的角色看，基础篇选用的材料是科技领域专业人员或媒体工作者向公众的交流，属于通俗易懂的书面语篇或口头话语，目的是向公众传播或交流与科学研究、技术发展有关的信息或观点。提升篇选用的材料是某专业领域人员向其他领域专业人员的交流，目的是满足他们对各专业领域科技信息的需求，这种材料的语篇类型属于通俗化的学术语篇。拓展篇选用的材料是专业领域人员向本专业或相关专业新生力量的交流，满足发展和培养该领域新生力量的需求，从语篇类型学的理论看，教科书是这种语篇类型的典型代表。应用篇选用的语篇是同领域专业人员之间的交流，学术论文是这一类型的典型代表，也包括各种研究报告、实验报告、立项申请报告。

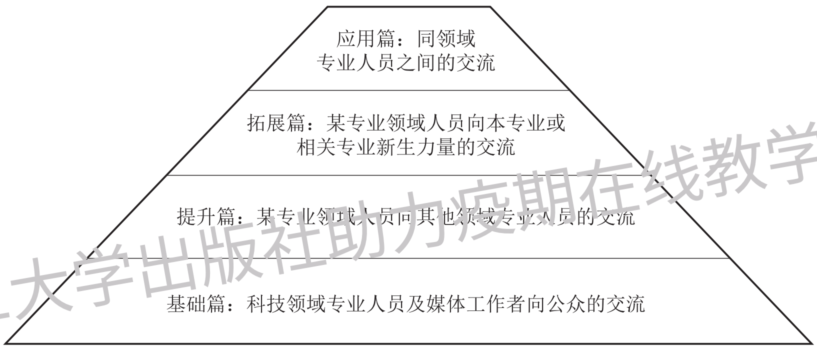

图 1　教学材料的语言难度、语篇形式规范程度、内容的专业程度逐渐上升

听力方面采用课下自主学习、课上讨论或小测验模式。书中为学生推荐了与每单元教学目标和内容相关的多媒体资源、相关网站或链接。

基础篇每单元提供 3 篇各 1 500 词左右的阅读材料，阅读材料选自英美通俗化科技期刊或综合期刊科技栏目，内容发人深省、触动人心，从科技教育、文理兼容，到发明创造、信息社会，从科技工作者的工作习惯、思维方式、团队精神，到学术诚信、职业道德等，内容丰富、体裁多样、文体生动、语言流畅。所推荐的听力材料为英美大众媒体简短报道和访谈节目，语音标准、语速正常，是语言运用的典范。

提升篇阅读材料涉及能源、交通、环境、基因工程、宇航、信息化、自动化等热门科技领域内的通俗化学术文章，内容前沿、信息量大。每个单元的阅读材料和听力材料主题相关，便于集中培养学生获取、提炼、分析、利用信息的技能。提升篇的教学重点是语篇层面，围绕各领域学术语篇共同的宏观交际功能、实现交际功能的修辞策略、语篇模式和信息选择与组织做周而复始的训练（见图 2），使学生的运用能力达到熟能生巧、融会贯通的程度。

一篇学术内容丰富的文章（无论是通俗期刊文章，还是专业期刊文章）往往具有很强的层次感，语篇层面英语教学的第一步就是训练学生能够很快地识别语篇的宏观功能、

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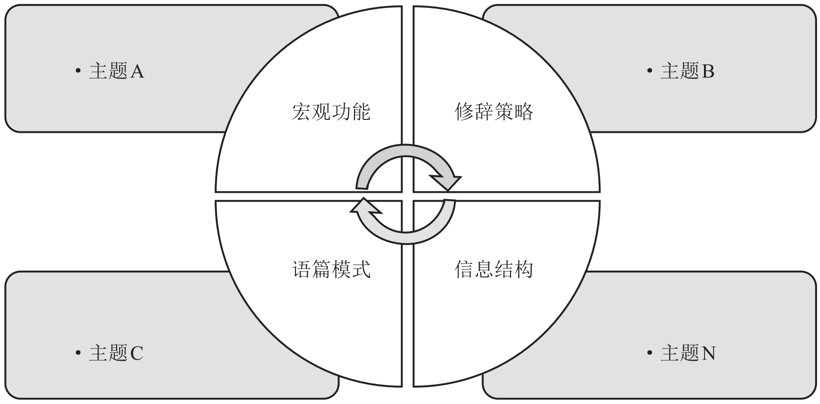

图 2　语篇能力训练过程

层次结构以及实现功能的方法与策略，以便准确理解文章的中心思想和核心内容。第二步是通过细读、语篇分析和写作练习掌握语言特征和写作技巧。

以一篇关于能源安全问题的文章为例。文章的宏观功能或宏观基调是论证自己的观点：大力开发核能是解决美国能源问题的最佳途径。宏观结构是问题—解决方法，但作者首先以具体事件论述能源危机对国民经济产生的连锁效应，然后站在他人的立场提出几种解决方案，包括风能和核能，讨论各自的优缺点。再通过对比的手法分析各自的利弊，并以德国模式（风能）和法国模式（核能）为例，说明风能的缺点和核能的优点，引导读者得出合理的结论：借鉴法国模式是最终解决美国能源问题的最佳方案。

这种材料语篇层面的论述方法有助于提高学生的思维能力和分析能力，微观语言层面的教学价值在于操练表达因果关系、连锁效应、比较与对照、正面和负面评价的方法。

拓展篇的材料选自英文原版教材、专著和技术报告章节，并将这些类型文献的核心部分优化为九种典型构建模块，即专业术语定义、技术概况、公式符号、图表、技术系统构造、工作原理和流程、技术性能、实验过程、分门别类。熟悉这些模块的结构特征和语言特征对提高各种专业文献的阅读效率起着举足轻重的作用。教学活动从阅读材料中的语言特征识别入手，强化专业文献阅读与写作中的精准意识和语体意识，排除阅读障碍，顺利向本专业文献阅读方向拓展。所推荐的听力材料为论坛、报告和课程节选，内容与每单元的主题和语篇类型相关，突出口头学术语篇的特征，强化语体教学效果。

应用篇共 9 单元，采用从语类宏观特征到微观特征教学的思路，便于学生了解语篇布局的严密性以及各个组成部分在整体结构中的作用。1～4 单元侧重文献综述报告、立项申请报告、技术报告和学术论文四种主要学术语类在宏观层面上的共性与差异性。第 5～9 单元侧重研究论文的引言、方法、结果、讨论、结论、摘要等部分在语言各层面上的特征和写作方法（见表 2）。教学活动从细读典型文本入手，围绕学术研究中提出问题、分析问题、解决问题的过程展开，激发学生提出创造性研究问题，使语言能力和思维能力同时得到训练和发展。所推荐的听力材料以各领域研究成果报道、对各领域研究问题

的讨论、名人访谈为主，强化教学效果。

表 2 教材目录

基础篇	
Unit 1	What Are Your Reasons to Become a Scientist or Engineer?
Unit 2	Are Children Born Scientists or Engineers?
Unit 3	What Makes a Successful Scientist or Engineer?
Unit 4	Is There a Divide Between Sciences and Humanities?
Unit 5	What Are the Strategies to Keep Yourselves Motivated?
Unit 6	Why Is Honesty the Best Policy in Science?
Unit 7	Is Necessity Invention's Mother or Vice Versa?
Unit 8	What Are Your Dream Teams Like?
Unit 9	Should Scientists Change Their Minds?
Unit 10	How Has the Digital Age Changed Your Lives?
Unit 11	Are You a Multitasker or Singletasker?
提升篇	
Unit 1	The Hydrogen Economy
Unit 2	Space Exploration
Unit 3	Clean Energy
Unit 4	Evolution
Unit 5	Mind and Brain
Unit 6	Climate Change
Unit 7	Automation
Unit 8	Genetic Engineering
Unit 9	Design: The Artist v.s. the Engineer
Unit 10	Epidemics
拓展篇	
Unit 1	Terms and Concepts
Unit 2	Symbols and Formulas
Unit 3	Tables and Figures
Unit 4	Overviews and Reviews
Unit 5	Systems and Mechanisms
Unit 6	Processes and Procedures
Unit 7	Properties and Characteristics
Unit 8	Tests and Experiments
Unit 9	Types and Classifications

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续表

应用篇	
Unit 1	Proposals
Unit 2	Technical Reports
Unit 3	Research Articles
Unit 4	Literature Reviews
Unit 5	Research Article Introductions
Unit 6	Research Methods
Unit 7	Results and Discussions
Unit 8	Research Article Conclusions
Unit 9	Academic Abstracts

4. 基于高质量输入材料，训练听、说、读、写综合技能

普遍认为，学术英语能力指英语专业文献阅读能力，在国际期刊上发表研究论文或在国际会议上宣讲研究论文的能力，以及在国际科研合作项目中的交流能力。这些能力包括对口头和书面学术语篇的理解能力和产出能力，即宏观的听、说、读、写能力。但这四种宏观能力以及各自所需要的各种微观语言能力相互联系、相互促进。大学生的学术英语能力培养应该重视宏观语言能力和微观语言能力的培养，并将听、说、读、写能力教学有机融合。

本套教材编写以阅读为切入口，通过阅读适合学生不同阶段水平的文献获取某一主题的信息、知识或观点，激发学生真实思想和信息交流的愿望，进行小组讨论，在讨论过程中对原文内容进一步消化，对原文的语言进行模仿和操练，提高语言理解与产出的互动强度，促进阅读理解和语言表达能力的提高。阅读与讨论的过程有助于对相同主题听力材料的理解。所听的材料为写作练习提供了丰富的内容，每一单元的写作练习基于所读、所听、所讨论的内容或观点。口头讨论活动也可以基于写作练习，先读后写，再将读、写的内容用于讨论中，加大口头交流活动中的信息量（见图 3）。

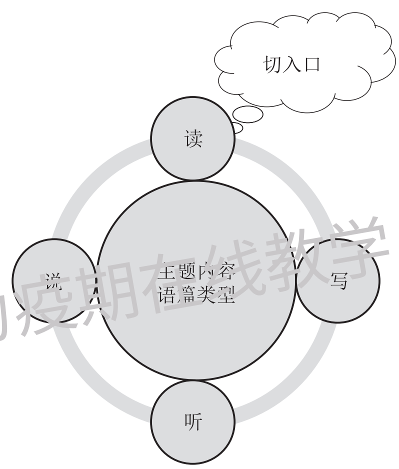

图 3　围绕主题内容或语篇类型的听—说—读—写技能训练

基础篇以简单地概括阅读文章的大意为主，提升篇在概括他人的论点或内容的基础上，加上自己的评论、观点和论述，并模仿、运用阅读材料中的修辞方法。拓展篇的阅读和写作均向更专业的语篇拓展，使学生掌握学术语篇的信息结构特征和修辞方法的运用，能够查阅资料、撰写一篇完整的文章介绍自己感

兴趣的理论、设备或技术系统，其中包括定义、特征、构造、工作原理等。也可以结合自己的课程，用英语写一篇完整规范的技术报告。应用篇训练学生独立查找、筛选、阅读、综述学术文献，提出自己的研究问题、设计研究方案，最后做口头陈述报告。

这些能力需要通过系统的、相互联系的、循序渐进的练习和实践才能达到，如从总结段落的主旨大意，到总结章节的主旨大意，最后用简洁、清楚、规范的语言概括整篇文章的论点或研究问题、数据采集方法、分析方法、得出的结果与结论等。这些能力所需要的微观技能（如区分主旨与细节，识别段落之间、章节之间的逻辑关系、信息结构，判断和处理专业词汇，选择增强或削弱表达力度的词、句式等）都需合理地分解并贯穿到整个教学过程中。

将专业知识、语篇知识、语类知识学习以及四种宏观语言技能培养融为一体的强化训练措施，不仅提高语言能力发展的效率，而且拓宽了国际学术视野，使学生受到思维方法、研究方法和学术素养的熏陶。

三、教材使用

北京理工大学英语教师已分期分批试用过本套教材。在改革之前，教师们面临学校教育教学环境的改变和人才培养目标的改变，承受着巨大的英语教学改革压力。从通用英语到学术英语的转向，也使他们忧心忡忡，疑虑重重。值得庆幸的是，教师们一旦使用本套教材，都异口同声地说“好用”。

不过，无论是教师还是学生，在本套教材使用过程中确实需要在英语教学与学习目的和方法理念上有较大的改变。

首先，要摆脱以往通用英语教学模式的束缚，特别是避免教师逐段通篇讲解的教学模式，而是围绕理解、整合、评述、利用信息的技能培养开展教学活动，培养学生在使用中持续发展英语能力的策略和方法，便于终身自主学习。

其次，正确认识自主学习和课堂教学的关系。课程学习中的自主学习概念不等于自学。避免学生自学、课堂上对答案的做法。教材中的练习答案本身不重要，也不是教学目的，而引导学生理解，思考，分析所读、所听的内容，甚至展开辩论，从而进行语言操练和思维训练的过程更重要。课堂上要有针对性地集中训练核心学术技能，学生课下自主学习和实践，再回到课堂进行讨论与交流，提高语言产出的质量，达到事半功倍的效果。

最后，要将原则性和灵活性相结合，尊重学生的专业兴趣和个性，灵活利用教学材料。拓展篇和应用篇以不同专业的文献为材料，使学生掌握学术语类的共同特征，起到触类旁通的作用。高年级学生或研究生可以将这些知识和技能用于专业学习和科学研究，阅读本专业的学术文献，完成写作任务。

本套教材自 2013 年起在北京理工大学部分本科生中试用，基础篇和提升篇供大一学生必修课使用，拓展篇和应用篇供徐特立英才班大二学生必修和全校本科生，硕士、博士研究生选修。

本套教材在试用期间得到学生的好评，第一学期学生最典型的感受是“不轻松，痛并快乐着”“开始很迷茫，后来发现收获很大”“充实，收获颇多”。第二学期完成提升篇后，普遍认为“能力提高很大”“每个单元都能给予我们新的知识、新的概念，都能让我们接触到从不曾有的想法”“不仅拓宽了知识面，还锻炼了口语”“在很大程度上培养了我们自主学习的能力，自己也有决心学好英语”。拓展篇完成后，典型的评价是“开始是根本无法想象自己能写出一篇大的科技文，觉得那些文章好高大上，是离自己很远的事情，没想到如今我竟然能自己写出一篇来”。学生不仅提高了英语能力，而且从学习中获得成就感和满足感，同时也训练了文献研究能力，有的学生说：“这次的写作挺有意思，自己去检索很多相关的论文文献，写的同时学到很多东西，除了内容上的，还有写作的方法技巧方面的。另外，做口头陈述也是很爽的，很久没有这样在讲台前‘指点江山’，很享受。”第四学期学完应用篇之后，要求每个学生用英语撰写与自己的科研项目（如大学生研究训练项目和数学建模比赛项目）有关的立项申请报告或结题报告，没有项目的学生可以撰写文献综述报告或实验报告，并做口头陈述。很多学生的习作能与英语国家同类院校优秀学生所完成的同类习作媲美。在口头陈述中，也都能够把自己的研究项目用英语讲得清清楚楚，完全达到甚至超过了预期教学效果。

编写本套教材对我们来说是一次全新的尝试和学习过程，在整个选材、编写和试用过程中充满了各种挑战，我们以坚韧不拔的探索精神和一丝不苟的工作态度来完成每一个环节。既要争分夺秒、提高编写速度，又要字斟句酌，保证教材质量，经常夜以继日、不遑暇食、乐此不疲。尽管如此，由于水平有限、时间仓促，教材难免有很多不足和问题。望广大同仁不吝赐教，也欢迎学生们批评指正，我们将虚心接受，等到教材修订时加以改进。联系方式：bitesp@163.com；2461168906@qq.com。

最后，我们深感欣慰的是，2015 年春天，全国《大学英语教学指南》征求意见稿出台，确立了通用学术英语在大学英语课程体系中的重要地位，本套教材如逢雨露春风，只待花开烂漫。

编　者

2015 年夏

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Contents

Unit 1

The Hydrogen Economy

Objectives

- Develop your skills to identify the discourse pattern and predict the types of information before reading a lengthy text carefully;
- Increase your awareness of the communicative purpose of writing and the choice of rhetorical strategies to achieve the communicative purpose;
- Acquaint yourselves with the method of organizing information chronologically;
- Summarize the history and current status of fuel cell technology;
- Analyze the advantages and disadvantages of fuel cell powered vehicles;
- Give an oral account of historical events with the help of time expressions;
- Predict the prospect of the widespread applications of fuel cell technology;
- Use word combination rules to help you build up technical vocabulary;
- Increase your sensitivity to heavy noun groups in scientific texts;
- Follow the flow of events with the help of time expressions when listening to a talk;
- Develop your skills to distinguish the main points from specific details when listening to science news, talks, or interviews.

Task 1: Familiarize yourselves with the following new words, set expressions or lexical chunks to prepare for reading the texts in this unit.

allude to	暗指，影射
alternative energy system alternative to	替代能源系统 替代，替代品
ambient air	环境空气
ammonia borane, NH_3BH_3	硼烷氨
ammonium borohydride, NH_4BH_4	硼氢化铵
Apollo 13 mission	阿波罗 13 号的飞行任务
appurtenance	配件

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continued

assert	断言，声称
awkwardly extreme temperature	难以控制的极端温度
barely exothermic	几乎不放热的
benchmark	参考标准
bid on (a project)	竞标（项目）
boulder	巨石
bring outside perspectives to discussions	讨论中征求业外人士的意见
broken bolt	破损的螺钉
buy into (the plan)	认可（该计划）
cadmium	镉
carbon dioxide emissions from hydrogen generation	在生产氢过程中的二氧化碳排放
Catch-22	第 22 条军规，左右为难的困境
cathode	阴极
change his trajectory	改变其运动轨迹
chassis	汽车底盘
compact portable power sources	小型便携式动力源
compound	化合物，混合物，复合物
compressor	压缩机
concept car	概念车
configuration	配置，结构
consortium	财团
cryogenic temperature	低温
decompose be decomposed by a catalyst at the anode into electrons and protons decomposition reaction	分解 在阳极由催化剂分解成电子和质子 分解反应
discharge and recharge	放电与充电
dry cell	干电池
electric generator	发电机
electric motor	电机
electrode	电极
electrolysis electrolyte	电解 电解质

continued

electromagnetic induction	电磁感应
electron	电子
energy-conversion device	能源转换装置
energy crunch	能源危机
energy density	能量密度
energy-producing ingredient	产生能量的配料
escalating percentages in subsequent years	以后逐年提高的比例
exhaust fume	废气
exotic technology	奇特的技术
final disposition	最终部署，最终处置
fledgling industry	新兴产业
forging full speed ahead	正在全速发展
fossil fuel	化石燃料
frustrated frustration	受到挫折的 挫折
fuel cell	燃料电池
futuristic	属于未来的
generate energy	产生能量
gestation period	酝酿阶段
hand-cranked	手摇的
hibernation go into forced hibernation hibernate	冬眠，不活跃状态 被迫进入冬眠状态 冬眠的，不活跃的
hit the showroom floor	在车展中成功
hurdle	障碍
hydrocarbon	碳氢化合物
hydroelectric plant	水电厂
hydrogen-powered automobile	氢气动力汽车
incandescent bulb	白炽灯
inertia and momentum	惯量和动量
infrastructure	基础设施
infuse ammonia borane into	将硼烷氨注入……

continued

instrumental	有作用的，作为工具的
integrated into a regular gas station	与普通加油站合并
intercept	拦截
internal combustion engine	内燃机
jurist	法学家
kinetic energy	动能
lawsuit	法律诉讼
lead, nickel, cadmium, sodium, lithium, aluminum, zinc	铅、镍、镉、钠、锂、铝、锌
lead-acid battery	铅酸电池
light truck and delivery van	轻型卡车和厢式送货车
liquefy	液化
lithium-ion battery	锂离子电池
make grandiose claims	发表夸张的言论
mark an incremental step toward	标志着朝……方向迈开一大步
mass and velocity	质量和速度
mechanical linkage	机械联动装置
methanol	甲醇
molten carbonate	熔融碳酸盐
multifaceted	多面的
nanometer-scale	纳米级
nanotechnology	纳米技术
next to nothing	几乎为零
nonrenewable resource	不可再生的资源
nudge modern society toward a hydrogen-based economy	促使现代社会向氢经济方向发展
opens up ways to	为……开辟途径
osmium and uranium	锇和铀
outfitting	装配
outnumber by more than three to one gasoline-engine cars	其数量是汽油动力车的 3 倍多
overall vehicle design	整车设计

continued

paradigm shift	范式转换
pay a premium	出高价
phosphoric acid	磷酸
podium	演讲台
potable water	饮用水
potassium hydroxide electrolyte	氢氧化钾电解质
prompt (sb. to do something) prompt the reaction	促使,引起 引发反应
proton-exchange membrane cell	质子交换膜电池
prototype vehicle	原型车
public roll-out	首次公开亮相
radar screen	雷达幕，关注范围
range	（续）驶（里）程
realm of the exotic	不熟悉的领域
residuum	残渣，残余物
resurgence	复活，再现
rhetoric	修辞，华丽的言辞
roof-to-bumper windshield	从车顶到保险杠的挡风玻璃（设计）
solid oxides or molten carbonate as electrolytes	固态氧化物或熔融碳酸盐作为电解质
solid polymer fuel cell	固体聚合物燃料电池
State of the Union Address	国情咨文报告
stationary equipment and portable devices	固定设备和便携装置
storage battery	蓄电池
strike out on his own	独立创业
surreptitiously	偷偷地
synthesize ammonia from hydrogen and nitrogen	用氢和氮合成氨
thermodynamic property	热力学特性
thin electrolytic membrane	电解薄膜
throttle, steering or brake	油门、方向盘和刹车
toxic	有毒的
turn something that large on a dime	使如此浩大的工程突然转向
unmuffled competitor	没有消音器的竞争对手（即汽油动力车）

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continued

unprecedented level of respect	前所未有的尊重
unveil	公布于众
venture capital	风险资本
veteran	退伍军人
voltaic pile preceded the fuel cell by 39 years	伏打电堆比燃料电池早 39 年
zero-emission vehicle	零排放车辆

Task 2: Skim through Text I and 1) match the subheadings on the left column with the types of information on the right, 2) identify the sentence in the opening section which indicates the types of information and the organization of the text, 3) explain why the author quotes President Bush's State of the Union Address.

Subheadings	The types of information
1) The Opening Section	A) The prospect of the hydrogen economy
2) The Gas Battery	B) The application of fuel cells in consumer electronics
3) Electric Car Resurgence	C) The development of various types of fuel cells
4) Into the Mainstream	D) The significance of fuel cell technology
5) Out of the Laboratory, Someday	E) The origin and development of fuel cell technology
6) Fuel-Cell Phone	F) The status of fuel cell cars

The sentence in the opening section which indicates the types of information and the organization of the text: ____

____

Text I

Fuel Cells[1]

Henry Petroski

1 In his **State of the Union address** early in 2003, President George W. Bush called for promoting energy independence for the United States while making dramatic improvements in the environment. The familiar **rhetoric** **alluded to** a comprehensive plan involving efficiency and conservation as well as developing cleaner technologies for

domestic energy production. But the President soon departed from the familiar and entered the **realm of the exotic** when he asked Congress to take "a crucial step and protect our environment" in distinctly new ways. In the 21^{st} century, he continued, "the greatest environmental progress will come about not through endless **lawsuits** or command-and-control regulations, but through technology and innovation." He proposed spending $1.2 billion on research into **hydrogen-powered automobiles**, which employ fuel cells.

2 The President went on to give an admirably concise definition of the principle of a fuel cell: "A single chemical reaction between hydrogen and oxygen **generates energy**, which can be used to power a car—producing only water, not **exhaust fumes**." He challenged scientists and engineers to overcome obstacles to taking fuel cell powered automobiles "from laboratory to showroom" in a time frame expressed not in cold calendar years but in the very warm and human image of growing up, "so that the first car driven by a child born today could be powered by hydrogen..." Such progress, the President **asserted**, **opens up ways** to protect the environment "that generations before us could not have imagined."

3 It was only the summer before President Bush's address that I was introduced to fuel cells in a more than passing way. Evidently because I had written about invention and the evolution of a wide variety of technologies, I was invited to join an Industry Advisory Committee then being formed by Chrysalix Energy, a Vancouver based **venture-capital** firm investing in early stage fuel-cell technology. In spite of my objections that I knew **next to nothing** about fuel cells, I was persuaded by the committee's chairman, Daniel Muzyka, Dean of Commerce at the University of British Columbia, to join the committee, whose purpose is to **bring outside perspectives to discussions** about an imagined hydrogen economy. In my association with the group thus far, I have participated in a few telephone-conference calls and attended a meeting in Amsterdam. I have heard many presentations and read a large number of books, reports, and articles about fuel cells, their promise, and their shortcomings. In addition, I have read and clipped magazine and newspaper stories that a year ago I might have passed over quickly and have generally become increasingly interested in the history, status and future of the technology.

The Gas Battery

4 Applications of the fuel cell may seem **futuristic**, but the device itself dates from 1839, when the Welsh-born British **jurist** and scientist Sir William Robert Groves devised a

"gas battery." Unlike Alessandro Volta's now-familiar **dry cell**—which contained all its **energy-producing ingredients** and which produced electricity only as long as it could sustain the chemical reaction—Groves's gas battery produced electricity as long as it was fueled by an external source. The simple **voltaic pile preceded the fuel cell by 39 years**.

5 Within a couple of decades of the invention of the dry-cell battery, Michael Faraday demonstrated the principle of the **electric motor** and soon thereafter that of **electromagnetic induction**, which led to the **electric generator**. By the early 1830s working electric motors were being made, and well before the end of the decade electric driven road vehicles and paddle boats were the subjects of experiments. By 1859, an early version of the **lead-acid battery** used in today's automobiles had been developed—with the most important capability of being repeatedly **discharged and recharged**. As early as 1873, **storage batteries** were powering electric motors and driving vehicles, and by 1882 these electric "cars" could reach speeds of almost 10 miles per hour and travel distances as great as 25 miles. The first demonstration of a vehicle powered by an **internal combustion engine** was still a couple of years away.

6 At the end of the 19th century, an electric vehicle held the world speed record of 61 miles per hour, and in the United States in 1900 almost as many electric-driven cars (1,575) were being manufactured as steam-driven ones (1,684). Combined, they **outnumbered by more than three to one gasoline-engine cars**. The electric vehicle had the clear advantage of quietness over its then **unmuffled competitors**, and it did not need to be **hand-cranked** to be started. However, after the introduction of the Ford Model K in 1906 and the Model T in 1909, the internal-combustion engine became the power source of choice. By 1912, there were 900,000 gasoline powered vehicles in America, outnumbering the 30,000 electrics thirty-to-one. At about the same time, the self-starter and silencer were introduced, thus making the internal combustion engine more user friendly and desirable. It was much faster to add gasoline to a tank than to recharge heavy batteries, and the gasoline provided greater **range**. (Different energy sources are now usually compared by means of a measure known as **energy density**, which is the ratio of power to weight. Today, a conventional lead-acid battery has an energy density of about 35 watt hours per kilogram compared with gasoline's 2,000, although more exotic types of batteries have higher energy densities than do lead-acid cells.) The use of gasoline-powered vehicles in World War Ⅰ conditioned a lot of young **veterans** to favor the internal-combustion engine. The last new model of an electric car to be built in America during that era was introduced in 1921—at a price four times that of a Model T. The electric vehicle essentially went into forced **hibernation** for decades, until

environmental and energy crises reawakened interest in a nonpolluting **alternative to** the internal combustion engine.

Electric Car Resurgence

7 Unfortunately, battery technology had not advanced sufficiently in the meantime to enable electric cars to be made attractive competitors to gasoline-driven ones in terms of size, range and cost. **Prompted** in part by the rise in consciousness of ecological issues, electric vehicles began to reappear around 1960, but only in small numbers. Indeed, it was not until 1990, when southern California's South Coast Air Quality District required that by 1998 large manufacturers have 2 percent of their sales in **zero-emission vehicles** (with **escalating percentages in subsequent years**), that major automobile companies began to look more seriously at alternatives to the internal-combustion engine. And among those alternatives were fuel cells, which had seen development for specialized applications. In particular, the Gemini and Apollo space programs employed fuel cells to provide power, while at the same time providing **potable water** as a by-product. The explosion of an oxygen tank and the consequent damage to a pair of fuel cells produced the life-threatening situation on the **Apollo 13 mission**, but fuel cells also served reliably for many other space flights. It was a matter of matching the technology to the application.

8 Just as dry-cell batteries come in a large variety of types and employ a wide range of different materials—**lead, nickel, cadmium, sodium, lithium, aluminum, zinc**—so do fuel cells. The ones powering spacecraft typically operate at relatively low temperatures and have **potassium hydroxide electrolyte**. Small stationary generators operating at intermediate temperatures may use **phosphoric acid**. Some fuel cells, which are suitable for use as large stationary generators, operate at high temperatures and use **solid oxides or molten carbonate as electrolytes**.

9 One of the most promising **configurations** has proved to be the **proton-exchange membrane cell**, which operates in the temperature range associated with internal-combustion engines and has a power density that makes it suitable for use in automobiles. The **electrodes** of this device are separated by a **thin electrolytic membrane**. When hydrogen is introduced under pressure, it is **decomposed by a catalyst at the anode into electrons and protons**. The electrons naturally make electricity, which can power a motor or other electrical devices. The protons move through the membrane toward the **cathode**, where another catalyst recombines them with spent electrons and oxygen from the **ambient air** to produce water.

10 The wide variety of fuel cells under development is to be expected in a **fledgling industry** populated by hundreds of private and scores of public companies. Among the best known of these is Ballard Power Systems, which is most closely associated with the proton-exchange membrane technology. After receiving a degree in geological engineering from Queens University, Canadian-born Geoffrey Ballard began his career in oil exploration, where he became increasingly **frustrated** when his opinions were ignored in favor of those from scientists with higher degrees. After going back to school and earning a doctorate in geophysics, Ballard began working for the U.S. Army as a civilian. During the 1973 energy crisis, Ballard was made director of research for a new government office of energy conservation. He was excited about the position and the possibilities, but he became disillusioned when he found that the research-and-development funding system expected results much more quickly than the 20-year **gestation period** required for new energy systems.

11 Ballard also became convinced that conservation was not the answer to the energy problems facing the U.S. and, especially, the Third World, whose people wanted to enjoy the level of abundance they saw in America and did not want to have to conserve to get there, if indeed that was a possible route. The real need, Ballard believed, was to develop **energy conversion devices** and techniques that were more efficient and cleaner than the traditional burning of **fossil fuels**. He also saw a need for lightweight and **compact portable power sources**. Thus, Ballard left his job in energy conservation and **struck out on his own** to develop smaller, lighter and more efficient batteries to power everything from video cameras to **light trucks and delivery vans**. He and a financial backer enlisted a chemist, who went to work developing a lithium battery, which in turn attracted further support to power a submarine. The battery work involved living hand-to-mouth, so the Ballard team was always looking for new funding opportunities.

12 When the company, which had started in Arizona, relocated to Vancouver, British Columbia, it was naturally on the lookout for Canadian government funding opportunities. One request for proposals that looked promising was for the development of a low-cost **solid polymer fuel cell**. Since this involved electrochemistry, something the Ballard group had become heavily involved with in its battery work, the project seemed like an ideal one to **bid on**. Ballard had had some experience with fuel cells while working for the U.S. Army, and he knew that the technology was working in the space program.

13 The challenge was not to demonstrate that fuel cells worked but to demonstrate that they could be produced for the consumer market. This meant, of course, that they had to be

manufactured with much higher power density and at much lower cost. With the help of **venture capital**, Ballard went on to produce stationary fuel cells, but the real challenge lay in demonstrating a fuel cell-powered vehicle, which meant fitting the power plant and the hydrogen supply to fuel it into a space with predetermined practical requirements and limitations—a bus, as it happens.

14 Meanwhile, in order to secure more capital, the founding members of Ballard Power had given up control of their company to a management team, which at first did not like the bus-project idea. But after Geoffrey Ballard secured federal and provincial support for the bus plan, management also **bought into** it. The **prototype vehicle** proved to be a resounding success when it had its **public roll-out** in 1993.

15 And roll out was literally what it did. As the bus stood idling beside Vancouver's Science World, ready to be driven around to the front as soon as the speeches were finished, the **compressor** suddenly quit. The problem was a **broken bolt**, and there was not time to fix it. So some Ballard employees **surreptitiously** pushed the bus to get it moving, after which it rolled down an incline and was steered to a stop in front of the **podium**. Since fuel cells were expected to be quiet, no one noticed that the bus had not been under power. After Geoffrey Ballard, who had been alerted to the crisis, and others had spoken of the significance of the occasion, the British Columbia premier announced, "Let's go for a ride." Fortunately, a large crowd had gathered around the bus, and reporters began to question the man responsible for the bus project, Paul Howard. He answered all their questions with great patience, finally telling everyone to come back that afternoon for a ride. The broken bolt was fixed during lunchtime, and the bus ran smoothly for the news cameras. Today, later-generation fuel-cell buses are carrying passengers in Madrid and other European cities.

Into the Mainstream

16 Geoffrey Ballard is no longer with the company that bears his name, but the fuel cell that was so **instrumental** in promoting to "change the world" has reached an **unprecedented level of respect** as an **alternative energy system**. Ballard Power Systems, which has registered the trademark, "Power to Change the World," is **forging full speed ahead**, having established partnerships with Daimler Chrysler, Ford and other automobile manufacturers. The goal is not only to supply the transportation industry with fuel cell engines but also to develop fuel-cell systems for **stationary equipment and portable devices**. And Ballard is, of course, not the only player in the game.

17 The General Motors **concept car** termed Hy-Wire (a word formed from hydrogen and

by-wire) is not only powered by a fuel cell but also controlled through "by-wire" technology similar to that already widespread in the aircraft industry. There are no **mechanical linkages** between driver and **throttle, steering or brakes**, since all such connections are by electrical wire, which leaves room for a more imaginative **overall vehicle design**. Since there do not have to be mechanical linkages between pedals and steering wheel and what they normally control, there do not have to be pedals or a steering wheel at all. Hence, the General Motors Hy-Wire vehicle is often described as a "skateboard design," in which the fuel cell and **appurtenances** are incorporated into a rather flat **chassis**, onto which a variety of body types can be mounted (and changed like clothing to fit the mood of the owner). Because there are no mechanical linkages between body and chassis, the imagination of automobile designers is freed up, which can mean a **roof-to-bumper windshield** and a handheld control system that is not unlike the videogame controllers with which younger generations have grown up. The concept car is also referred to as the China car, since it is expected to become available as early as 2008 but no later than 2015—or simultaneously with a potentially booming auto market in Asian countries and elsewhere around the world, where private vehicle ownership currently rests at only 12 percent.

18 Fuel cells are expected not only to revolutionize the appearance and control of automobiles; they can also greatly change the perception of them as noise-and air-polluters. Since the fuel cell itself has no moving parts, the only sound associated with its operation comes from the devices needed to supply the fuel. (This lack of engine noise was the most striking feature of the first electric vehicle I rode in.) Also, since the only by-product is water vapor, in place of smelly exhaust fumes there will be but wisps of warm vapor or drips of distilled water. Instead of the present image of internal-combustion vehicles as greater polluters of cities than the horses that they displaced about a century ago, fuel-cell powered vehicles could be seen as saviors of the planet—if the problem of **carbon dioxide emissions from hydrogen generation** can be solved.

Out of the Laboratory, Someday

19 Although hydrogen is the most abundant element in the universe, its gaseous form does not occur naturally on Earth. Thus, another source of energy must be employed to produce free hydrogen from its **compounds**. Unfortunately, at least in the early stages of fuel-cell use, hydrogen is likely to be produced from a **hydrocarbon** such as natural gas, which is a less efficient process than that used to convert oil into gasoline. This is also a

nonrenewable resource, and the greenhouse gas carbon dioxide is produced in the process of releasing the hydrogen. Hydrogen can also be made from water, by **electrolysis**, but it is not as efficient a process. Thus, how to extract large quantities of hydrogen cleanly and efficiently remains a topic of some debate.

20 Of course, the "hydrogen economy" will become a reality only when the elemental gas is as readily available as gasoline is now. In the United States currently, hydrogen-powered cars and buses must be refilled at specialized sites, but Shell Hydrogen has announced plans to have a system for the new fuel **integrated into a regular gas station** in the Washington, D.C. area shortly. The cost of **outfitting** just one such station with the necessary tanks and pumps has been estimated to be between $500,000 and $1 million. At the higher estimate, making hydrogen available at 30,000 gas stations would involve a $30 billion investment, but this is not considered out of the question for introducing a new energy source. A pipeline to bring natural gas from Alaska has been priced at more than $20 billion, and the cost of a single nuclear plant can exceed $10 billion.

21 Thus, the widespread availability of hydrogen at corner locations, although it requires a major commitment on the part of fuel distributors, is in fact within reach. However, the hydrogen economy still faces the familiar **Catch-22** associated with technological change: The **infrastructure** needed to facilitate a **paradigm shift** is not likely to be put into place until the paradigm shifts, but that is not likely to happen until the proper infrastructure exists. In the final analysis, change depends on the technological pioneers who are willing to undertake rough rides over unpaved roads and carry their toolboxes and extra fuel along with them.

22 By the time fuel-celled vehicles are on the road in large numbers, they can be expected to carry enough hydrogen to give them a range as great as today's gasoline powered vehicles. The early demonstration vehicles powered by fuel cells had to be fitted with large hydrogen-storage tanks, which either encroached on interior space or perched obtrusively on the roof. This is not much of a problem for buses, but it certainly is for stylish automobiles. The storage problem must be dealt with before sleek, roomy vehicles with competitive ranges **hit the showroom floor**.

Fuel-Cell Phone

23 Some industry observers believe that fuel cells' first big inroad to the marketplace will be in consumer electronics, an area in which customers have already demonstrated a willingness to **pay a premium** for novelty and convenience. Indeed, it has been said that "half the interest in fuel cells is out of **frustration** with batteries." Fuel cells can provide

power for a much longer time than batteries. One **benchmark** of the portable-power industry is how many hours of continuous power can be gotten out of a kilogram of fuel. The comparison is striking: Pure hydrogen, as high as 38,000 hours; **methanol**, from which hydrogen can be extracted, 6,000 hours; a fully charged **lithium-ion battery**, 150 hours. (But these numbers do not include the size of the container, which can be much larger for a kilogram of hydrogen than for methanol.) Unfortunately, unless they are carefully matched to the application, fuel cells are not capable of delivering large bursts of power. Hence, it is foreseen that they will be combined with batteries in many applications, thus exploiting the advantages of each.

24 The recent developments in the consumer electronics industry are likely to accelerate the move toward fuel cells as power sources. Sony, Samsung and others have begun introducing products that combine previously separate devices, such as a cell phone, personal digital assistant, digital camera and MP3 player, with the capability of being continuously connected to the Internet. Such **multifaceted** electronic gadgets also come with relatively large color screens, and their power demands thus consume batteries as quickly as teenagers do soft drinks. Electronics manufacturers are therefore experimenting with powering multi-devices with fuel cells.

25 There is also considerable effort going on in other areas. In Japan, a Ballard partnership recently **unveiled** a pre-commercial version of a stationary one-kilowatt fuel-cell generator capable of providing private residences with power and heat. The system is expected to be on the market by the end of next year. Ballard, which has stated that it wants to complete its transformation "from a technology-focused research and development organization into a customer-focused production organization," appears to be well on its way to fulfilling its objective.

26 Ballard is far from the only player moving ahead in the fuel-cell business. For more than a year now, six 200-kilowatt fuel cells have been providing power for a juvenile training school in Middletown, Connecticut. The state has encouraged clean energy and is home to a number of small start-up companies focusing on fuel-cell research and technology development. It is also the location of fuel-cell manufacturers, including UTC Fuel Cells in South Windsor, which at the end of 2002 was said to be the "world leader in fuel cell production at this point in time." The fuel-cell power plant at Middletown not only provides electric power for the campus but also is used to heat and cool the buildings. It came at a high price, however, for the installation of the forward-looking power plant accounted for about 37 percent of the $49 million total cost of the 227,000-square-foot facility. The decision to employ fuel cells there would not likely have been made without

government involvement.

27 But President Bush has asserted the participation of the U.S. government, at least at the research level, and his enthusiasm for a hydrogen future brought considerable renewed attention to what has for so long been an obscure technology promising clean and quiet power. Just weeks after the State of the Union address, Canada's Finance Minister, John Manley, announced an additional $2 billion (Canadian) in funds for "sustainable development" in that country. Canadian fuel-cell interests hope to get some of that money for their ongoing research-and-development efforts, but its **final disposition** is not yet certain. Still, it is a good bet that before long today's **exotic technology** will be familiar, not only in North America but around the world.

Task 3: Identify the time expressions in "The Gas Battery" section and complete the following outline to trace the historical development of battery technology and its applications.

1) In 1800 (Inferred from the sentence "The simple voltaic pile preceded the fuel cell by 39 years.") ______________________________

____

2) In the 1820s (inferred from "Within a couple of decades of the invention of the dry-cell battery"), ______________________________

____

3) By the early 1830s ______________________________

4) In 1839 ______________________________

____

5) Well before the end of the decade, ______________________________

____

6) By 1859, ______________________________

____

7) In 1873, ______________________________

____

8) By 1882, ______________________________

____

9) At the end of the 19^{th} century, ______________________________

____

10) In 1900, ______________________________

____

11) In 1906-1909, ____

____

12) By 1912, ____

____

13) In 1921, ____

____

Task 4: Identify the time expressions in the "Electric Car Resurgence" section and note down Geoffrey Ballard's experiences and efforts to develop new power systems. Organize the notes into a paragraph in chronological order.

1) After receiving a degree in geological engineering from Queens University, ____________

____

____

2) After going back to school and earning a doctorate in geophysics, ________________

____

3) During the 1973 energy crisis, ____

____

4) When Ballard was convinced that conservation was no answer to the energy problems, ___

____

____

5) When his company relocated to Vancouver, British Columbia, ________________

____

____

6) With the help of venture capital, ____

____

7) After Ballard secured federal and provincial support for the bus plan, ________________

____

____

8) In 1993, ____

____

Summary:

____

____

____

____

____

____

Task 5: Determine which of the following is the communicative purpose of the "Into the Mainstream" and "Out of the Laboratory, Someday" sections. Explain the problems to be solved before fuel cell powered vehicles can be widely used.

The communicative purpose of the two sections:

1) To evaluate Geoffrey Ballard' contribution to power technology.

2) To inform the reader of the present status of fuel cell technology.

3) To explain the problems of the automobile industry around the world.

4) To persuade the reader to support the hydrogen-based economy.

Problems

1) ____

____

____

2) ____

____

____

3) ____

____

____

4) ____

____

____

Task 6: Answer the following questions based on the last section of Text I.

1) In what industries or areas are fuel cells more likely to be used in the near future?

____.

2) What examples are given to illustrate the application of fuel cells?

____

____

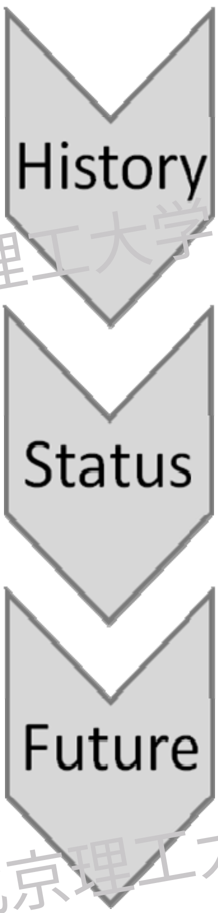
3) What is the prospect of fuel cell technology according to the author?

____

____

Task 7: Complete the following diagram which reflects the communicative purpose and information structure of Text I.

Note: The writer of an article always has a particular communicative purpose in mind. It may be a body of information to convey, an opinion to express, a problem to solve, a theory to propose, or a controversial issue to discuss, etc. The author's thoughts are rhetorically organized to form discernible segments or chunks, which are like "building blocks" for the construction of a lengthy text. The types of information and the ways of organizing the information are the author's choices, efforts or means to achieve the communicative purpose. Thus they can be regarded as rhetorical strategies. Very often several rhetorical strategies are needed for the construction of a lengthy text in order to achieve the author's communicative purpose.



History

- Information segments: gas battery, its application, electric vehicles, Ballad Power Systems, etc.
- Rhetorical strategies: narration, historical accounts of events according to time order

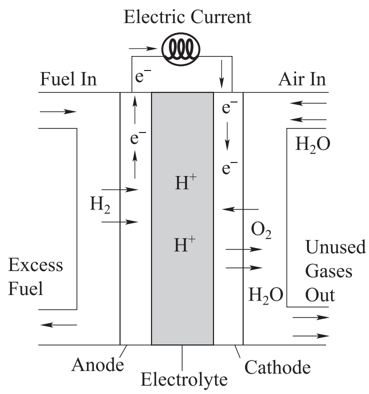
Status

- Information segments:
- ____
  ____
- Rhetorical strategies:
- ____
  ____

Future

- Information segments:
- ____
  ____
- Rhetorical strategies:
- ____
  ____

Task 8: Describe the mechanism or principle of proton-exchange-membrane fuel cells based on the information in paragraph 9 and the following diagram.



Note: A mechanism refers to the interconnectivity between parts of a system and the causal relationships between processes within the system. You can use the following sentences in your discussion.

- The electrodes of the cell are separated by a thin electrolytic membrane.
- Hydrogen is introduced under pressure.
- A catalyst decomposes hydrogen into electrons and protons at the anode.
- The electrons make electricity to power a motor.
- The protons move through the membrane toward the cathode.
- A catalyst combines protons with spent electrons and oxygen from ambient air.
- Water is produced.

Task 9: Explain the meaning of the following list of heavy noun groups. They can be regarded as technical word chunks.

Note: A heavy noun group consists of a head noun and two or more modifications which are either before or after the head noun. They may look complicated, but on the contrary, they are widely used in technical writing exactly because of their simplicity, convenience, and accuracy. The modifications often stand for a clause, a prepositional phrase, or a participle phrase. The following are some examples.

- **early-stage fuel-cell technology:** fuel cell technology at the early stage of its development
- **lead-acid fuel cell powered vehicle:** vehicles that are powered by lead-acid fuel cells
- **technology-focused research and development organization:** an organization which aims at the research and development of new technologies
- **customer-focused production organization:** an organization which aims at manufacturing products for customers

- **research-and-development funding system:** a system for providing funding for research and development

1) proton-exchange membrane cell
2) proton-exchange membrane technology
3) electric-driven road vehicle
4) fuel-cell powered vehicle
5) energy-conversion devices and techniques
6) roof-to-bumper windshield
7) more imaginative overall vehicle design
8) low-cost solid polymer fuel cell
9) lightweight and compact portable power source
10) greenhouse gas carbon dioxide
11) potassium hydroxide electrolyte
12) high power density
13) energy-producing ingredient
14) carbon dioxide emission
15) electric-driven car
16) gasoline-engine car
17) gasoline-powered vehicle
18) dry-cell battery
19) internal combustion engine
20) zero-emission vehicle
21) hand-held control system
22) hydrogen powered automobile
23) venture-capital firm
24) lead-acid battery
25) command-and-control regulation
26) stationary one-kilowatt fuel-cell generator

***Task 10:** Use the prefixes and words provided to form as many new words as possible. Word formation techniques would help you understand the meaning of unknown technical words.*

bio-	charge	

continued

de-	carbon	
di-	number	
dis-	oxide	
dys-	physics	
electro-	fuel	
geo-	compose	
hydro-	code	
mechano-	formation	
mono-	generate	
multi-	magnetism	
non-	mechanics	
out-	dimensional	
over-	function	
re-	chemistry	
trans-	degradable	
under-	renewable	

Task 11: ***Work in groups and discuss the advantages and shortcomings of fuel-cell powered vehicles and IC engine vehicles.***

Vehicle types	Advantages	Shortcomings
Fuel-cell powered vehicles	______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______
IC engine vehicles	______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______

Task 12: ***Read Text II and explain the author's communicative purpose. Note down why the author thinks that a rapid energy transition is impossible.***

The author's view of a rapid energy transition: A rapid energy transition is impossible.

Reason for this view: Our existing energy system has such a great inertia and momentum that you cannot change it no matter how hard you try.

Explanations:

- Inertia ______
- Momentum ______
- Technological momentum ______
- Labor-pool momentum ______
- Economic momentum ______

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Text II

The Impossibility of Rapid Energy Transitions[2]

Kenneth P. Green

Understanding energy system **inertia and momentum** is key to judging whether a rapid transition toward any type of energy is feasible.

I am tonight setting a clear goal for the energy policy of the United States. Beginning this moment, this nation will never use more foreign oil than we did in 1977—never. From now on, every new addition to our demand for energy will be met from our own production and our own conservation. The generation-long growth in our dependence on foreign oil will be stopped dead in its tracks right now and then reversed as we move through the 1980s, for I am tonight setting the further goal of cutting our dependence on foreign oil by one-half by the end of the next decade—a saving of over 4 1/2 million barrels of imported oil per day.

—Jimmy Carter

1 Politicians are fond of promising rapid energy transitions. Whether it is a transition from imported to domestic oil or from coal-powered electricity production to natural-gas power plants, politicians love to **make grandiose claims**. Unfortunately for them (and often the taxpayers), our energy systems are a bit like an aircraft carrier: They're unbelievably expensive, they're built to last for a very long time, they have a huge amount of inertia (meaning it takes a lot of energy to set them moving), and they have a lot of momentum once they're set in motion. No matter how hard you try, you can't **turn something that large on a dime**.

Inertia and Momentum: An Overview

2 In physics, moving objects have two characteristics relevant to understanding the dynamics of energy systems: Inertia and momentum. Inertia is the resistance of objects to efforts to change their state of motion. If you try to push a **boulder**, it pushes you back. Once you've started the boulder rolling, it develops *momentum*, which is defined by its **mass and velocity**. Momentum is said to be "conserved," that is, once you build it up, it has to go somewhere. So a heavy object, like a football player moving at speed, has a lot of momentum—that is, once he's moving, it's hard to change his state of motion. If you want to **change his trajectory**, you have only a few choices: You can **intercept** him, transferring (possibly painfully) some of his **kinetic energy** to your own body, or you

can approach alongside and slowly apply pressure to gradually alter his trajectory.

3 But there are other kinds of momentum as well. After all, we don't speak only of objects or people as having momentum; we speak of entire systems having momentum.

Technological Momentum

4 One kind of momentum is *technological momentum*. When a technology is deployed, its impacts reach far beyond itself. Consider the **incandescent bulb**, a current object of hatred for many environmentalists and energy-efficiency advocates. The incandescent light bulb, invented by Thomas Alva Edison, which came to be the symbol of inspiration, has been developed into hundreds, if not thousands, of forms. Today, a visit to a lighting store reveals a stunning array of choices. There are standard-shaped bulbs, flickering flame–shaped bulbs, colored globe–shaped bulbs, outdoor spotlights and floodlights, and more. It is quite easy, with all that choice, to change a light bulb.

5 But the momentum of incandescent lighting doesn't stop there. All of those specialized bulbs led to the building of specialized light fixtures. It's easy to change a light bulb, sure, but it's harder to change its fixture.

6 And there's more to the story, because not only are the devices that house incandescent bulbs shaped to their underlying characteristics, rooms and entire buildings have also been designed in accordance with how incandescent lighting reflects off walls and windows.

Labor-Pool Momentum

7 Another type of momentum we have to think about when planning for changes in our energy systems is *labor-pool momentum*. It's one thing to say that we're going to shift 30 percent of our electricity supply from, say, coal to nuclear power in 20 years. But it's another thing to have a supply of trained talent that would let you carry out this promise. That's because the engineers, designers, regulators, operators, and all of the other skilled people needed for the new energy industry are the specialists who have to be trained first (or retrained, if they're the ones being laid off in some related industry), and education, like any other complicated endeavor, takes time. And not only do our prospective new energy workers have to be trained, they have to be trained in the right sequence. One needs the designers, and perhaps the regulators, before the builders and operators, and each cohort of workers in training has to know there is work waiting beyond graduation. In some cases, colleges and universities might have to change their training programs, adding another layer of difficulty, given the prevalence of tenure in academia.

Economic Momentum

8 By far the biggest type of momentum that comes into play when it comes to changing our energy systems is *economic momentum*. The major components of our energy systems, such as fuel production and refining and electrical generation and distribution, are costly installations that have lengthy life spans and that have to operate for long periods of time before the costs of development have been recovered. When investors put up their money to build, say, a nuclear power plant, they expect to earn that money back over the planned life of the plant, which is typically between 40 and 60 years. Some coal power plants in the United States have operated for more than 70 years! The oldest continuously operated commercial **hydroelectric plant** in the United States is on New York's Hudson River, and it went into commercial service in 1898.

9 As Vaclav Smil points out, "All the forecasts, plans, and anticipations cited above have failed so miserably because their authors and promoters thought the transitions they hoped to implement would proceed unlike all previous energy transitions, and that their progress could be accelerated in an unprecedented manner."

10 When you hear people speaking of making a rapid transition toward any type of energy, whether it's a switch from coal to nuclear power, or a switch from gasoline-powered cars to electric cars, or even a switch from an incandescent to a fluorescent light, understanding energy system inertia and momentum can help you decide whether their plans are feasible.

Task 13: Read Text III and note down the main points of a new method for hydrogen storage.

The problem with wide applications of hydrogen based fuel cells in transportation: ____________

____

A new method used by Tom Autrey's team to store hydrogen:

____

____

Explanations:

- The method to get hydrogen out of ammonia borane __________________________
  ____
  ____
- Autrey's explanation of the process __________________________
  ____
  ____

- The challenge to this method ______________________________

____

____

Text III

Filling up with Hydrogen[3]

David Schneider

1 In June, Honda leased its first hydrogen-powered, fuel-cell car to ordinary consumers, the Spallino family of Redondo Beach, California. That transaction **marks an incremental step toward** the hydrogen-fueled transportation system that President Bush championed in his 2003 State of the Union Address, when he announced a $1.2 billion "Freedom Fuel" initiative. That program, among other things, funds research on the longstanding problem of how to store hydrogen on a vehicle, one of the many possible problems in the effort to **nudge modern society toward a hydrogen-based economy**. The trick is figuring out how to hold hydrogen safely and at sufficient density to allow a typical car to go 500 kilometers or so before having to tank up. While that requirement remains a significant **hurdle**, a new study indicates that the clever use of **nanotechnology** may give hydrogen storage a significant boost.

2 The surprising report, which appeared last June in the journal *Angewandte Chemie*, describes a way of storing hydrogen in the form of the compound **ammonia borane**, **NH_3BH_3**. Tom Autrey of the Pacific Northwest National Laboratory led the group of 12 authors who published the work. It builds on the decades-old idea of storing hydrogen in the form of ammonia, NH_3. Unlike hydrogen gas, which requires **cryogenic temperatures** to **liquefy**, ammonia becomes a liquid at −34 degrees Celsius. It also does so at room temperature and 9 atmospheres pressure, making it much more convenient to use as a transportation fuel. Ammonia is comparatively inexpensive to produce, and the hydrogen can be separated out using catalysts without undue losses.

3 "It's a perfect fuel in many ways," says Ali T. Raissi, head of the hydrogen research and development division at the Florida Solar Energy Center, part of the University of Central Florida. "The only problem it has is the fact that it's **toxic**." This consideration suggests that a better strategy might be to use the compound ammonia borane, which typically takes the form of a powdery solid. This chemical (and its cousin **ammonium**

borohydride, NH_4BH_4) was first studied in the 1950s for its possible use in rocket fuel, an idea that was later abandoned. It largely fell off scientists' **radar screens** until the late 1990s, when Gert Wolf of the Technische Universität Freiberg realized that it might be a good medium for storing hydrogen in a vehicle. Indeed, ammonia borane contains almost 20 percent hydrogen by weight, giving the compound more hydrogen per unit mass or volume than even liquid hydrogen.

4 Getting the hydrogen out of ammonia borane isn't difficult and doesn't require additional energy: Once the compound is heated sufficiently, the **decomposition reaction** proceeds on its own. A third of the hydrogen is released at about 110 degrees, a second third at about 155 degrees (at which point ammonia borane is a liquid) and the final third at a higher temperature still, more than 500 degrees. Because the last increment requires **awkwardly extreme temperatures**, the new work of Autrey and his colleagues focused on the first two steps, whereby two-thirds of the hydrogen can be extracted.

5 Autrey's team **infused ammonia borane into** a **nanometer-scale** scaffolding of silica, a type of material often used as a substrate for catalysts because it provides an enormous surface area for reactions. Doing so allowed the hydrogen-release reaction to take place at lower temperatures and to give off less energy. In chemist Autrey's words: "It's just **barely exothermic**." That difference is important for two reasons. First, it allows engineers to consider using the waste heat from fuel cells to **prompt the reaction** (the most popular type of fuel cells heat up to about 85 degrees). More important, the change in **thermodynamic properties** means that driving the reaction in the opposite direction—regenerating the ammonia borane by somehow putting hydrogen back—becomes less difficult, at least in theory. As Autrey explains, "If you're going to regenerate the stuff, you don't have to go uphill so far."

6 But figuring out exactly how to regenerate ammonia borane from the **residuum** left after hydrogen has been extracted remains a stumbling block. And T. Raissi notes that this is going to be very challenging. "You've got to be smarter than Haber, smarter than Bosch," he says, referring to the German chemists Fritz Haber and Carl Bosch, who at the turn of the 20th century pioneered a system to **synthesize ammonia from hydrogen and nitrogen** by combining these gases at high temperature and pressure in the presence of **osmium and uranium** catalysts—the system used around the world today to manufacture synthetic fertilizer.

7 Autrey agrees that regeneration is critical and says that he and his colleagues are working on the problem in collaboration with others in the **consortium** of government, university and industrial labs that make up the Department of Energy's Center of Excellence for

Chemical Hydrogen Storage. But he is otherwise tight-lipped about what avenues his group is investigating. Perhaps their best efforts will fail to resolve this critical issue. Or, just maybe, wielding computational, theoretical and experimental tools not available a century ago, Autrey's interdisciplinary team (or another one) will yet outwit Haber and Bosch. Doing so could help make hydrogen the fuel of choice in future vehicles.

8 Would such a change relieve the **energy crunch** and lower the amount of carbon dioxide released into the atmosphere? That all depends on how one gets the hydrogen, which, after all, is just serving as an energy carrier. Skeptics point out that it would probably come from natural gas, in which case the shift to a hydrogen-based transportation system would not fundamentally resolve current concerns. But at least the term "gas station" would finally make some sense.

Task 14: Complete the following report with the words and collocations you hear.

Who was the greenest president? A recent survey of green groups aimed to find out which presidents had the most environmentally friendly policies.

The top two spots, naturally, went to Republicans: Teddy Roosevelt and Richard Nixon. Roosevelt dominated the survey for his championing of the nascent idea of (1) ________________________ more than a century ago. Nixon garnered support for his passage of landmark legislation like the Clean Air and Clean Water Acts as well as the establishment of the (2) ________________________ Agency.

Rounding out the top three was Jimmy Carter, who gained points for actions like putting (3) ________________________ on the White House.

Who came in fourth? Barack Obama, thanks to often (4) ___________________ steps like raising a car (5) _______________________ and making (6) ________________________ projects a big part of the federal stimulus package.

Of course, the modern Republican party, including candidate Mitt Romney, has turned against conservation. If Romney likes coal, then he must love (7) ________________________ and (8) ________________________. The original Republican president, Lincoln, may have created the first (9) ________________________, but his heirs today are more interested in opening such public lands for (10) ________________________ exploitation.

Task 15: Note down some of the inventions in the 20th century which have greatly improved people's lives.

1) In 1875, if you wanted to read at night, you needed to have an oil or a gas lamp. By 1929, ____

2) In the late 19th century, women spent two days a week doing the laundry. By 1950, we had ____

3) In the late 19th century, the only source of heat was a big fireplace in the kitchen. By 1950, we had ____

4) Before 1879 transportation depended entirely on the urban horse. By 1929, ____

5) In 1900, the ratio of motor vehicles to the number of households was zero. 30 years later, the ratio reached ____

6) In 1885, the average North Carolina housewife walked 148 miles a year carrying 35 tons of water. By 1929, cities around the country ____________________

7) In the late 19th century, waterborne diseases ____________________

8) In the first half of the 20th century ____________________

9) By 1960 telephone bills, bank statements were being produced ____________________

Task 16: Answer the following questions according to a program about the properties of lithium, the third element on the periodic table.

1) Why are lithium and batteries almost synonymous?

____

____

2) What are the two elements before lithium on the periodic table?

____

____

3) What is crucial about lithium?

____

____

4) What does the professor say about the weight of lithium?

____

____

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Task 17: Note down the main points of President Obama's State of the Union Address in which he explains his administration's research, technology and energy policies.

1) His policy about responsible young people:

____

____

2) His attitude towards basic research and the reasons:

____

____

3) His plans for oil and gas exploration:

____

____

4) American oil production now:

____

____

5) His energy strategy:

____

____

6) His policy about renewable energy:

____

____

Task 18: Note down the main reasons why the market for electric cars is limited in the UK in spite of the government's promotional efforts.

1) ____

2) ____

3) ____

Task 19: Note down the main points of the speaker's view on hydrogen economy.

1) The key question about hydrogen economy:

____

____

2) Hydrogen can come from many different sources:

____

____

3) The distance between hydrogen fueling stations:

____

____

4) The real exciting vision:

____

____

Task 20: Work in groups and share each other's knowledge of our government's policies related to electric cars. Explain your attitude towards these policies and electric vehicle development.

Task 21: Use the information from this unit to analyze the prospect of hydrogen based fuel cells to power vehicles. If you think that widespread applications of hydrogen based fuel cells in transportation have a promising prospect, focus on the advantages, government efforts, and technological preparations. If you think otherwise, focus on the challenges or problems.

Unit 2

Space Exploration

Objectives

- Predict the content and the types of information according to the title and subheadings of an article;
- Acquaint yourselves with the General-Particulars discourse pattern in text construction;
- Distinguish general statements from specific details in the description of topography and landscape;
- Note down the similarities and differences between Mars and the Earth;
- Describe the landscape of Mars with the help of your notes;
- Distinguish facts from inferences and hypotheses about Mars;
- Make inferences about Mars on the basis of known facts;
- Use expressions and structures to draw inferences and make hypotheses;
- Define questions to be answered by future Mars missions;
- Note down the main points of science news reports about space exploration.

Task 1: Familiarize yourselves with the following new words, set expressions or lexical chunks to prepare for reading the texts in this unit.

a bank of snow and ice	一层冰雪
admonition	告诫
aeolian activity	风力活动
aeolian erosion or deposition	风蚀或沉积
aftermath	后果
alpha particle x-ray spectrometer	阿尔法粒子 X 射线谱仪
anion	阴离子
aquifer	含水层
artificial satellite manned satellite unmanned satellite	人造卫星 载人卫星 不载人卫星

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continued

astounding creative power	惊人的创造力
atmospheric cycle atmospheric pressure	大气循环 大气压
attest to an abundance of water	证明有丰富的水
barren, cratered world	贫瘠、坑洼不平的世界
basaltic	玄武岩
blanketed with a mixture of snow and dust	覆盖着一层雪尘混合物
canyon	大峡谷
celestial limits that earth-bound humans could not transgress	地球人无法跨越的天体范围
chariot	战车
chemical weathering of the underlying bedrock	基岩的化学风化作用
chlorine	氯
come to the fore	凸显出来
condensation	凝结
confluence	汇集
conjecture	推测
corona	日冕
cosmonaut (astronaut)	宇航员
culminate in	达到顶点，以……而告终
decay	衰变，衰减
deluge	洪水
distinctively pitted terrain	坑洼不平的特殊地貌
dust avalanche dust devil dust storm	尘崩 尘卷风 尘暴
eon for eons	千古 长期以来
equatorial region	赤道区
formed by surface runoff from rainfall or snowfall	雨雪流经地表而形成
gap in our knowledge	知识空白

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continued

geyser	间歇喷泉
grand convergence of	大融合
grapple with Earth's own history	努力了解地球的历史
gully	深沟
high in altitude	海拔高
high-resolution image	高分辨率图像
hospitable to evolution of life	有利于生物进化的
impacts reworked the landscape	陨石撞击改变了地貌
inflatable airlock	充气密封舱
infrared image infrared spectra infrared spectrometer	红外图像 红外光谱 红外光谱仪
intense meteor bombardment intense scientific scrutiny intensive volcanism	陨石的猛烈撞击 严格的科学检验 剧烈的火山活动
intriguingly	神秘的是，有趣的是
lander	着陆器
lunar module	登月舱
mantle of icy dust	覆盖着一层冻土
mineralogy	矿物学特征
notable noted be notable for be noted for	著名的，著称的 以……而著名
off course	偏离预定轨道
oracular power	神谕的力量
orbiter orbiting the planet	轨道飞行器 绕该行星轨道运行
permafrost layer	永冻层
polar ice cap	极地冰冠
precipitation	降水
preoccupy be preoccupied with	使全神贯注 全神贯注于，专注于
pristine	处于原始状态

continued

proliferating plants	繁茂的植被
recharge the groundwater	回补地下水源
reminiscent of	使人联想到
rover	巡视探测器
sacred realm of the gods	属于神明的神圣王国
sand dune	沙丘
sand sheet	沙原
satellite launch	卫星发射
sate our voracious curiosity	满足我们永无止境的好奇心
scabland	贫瘠而崎岖的地带
sedimentary debris	沉积的碎片
solar eclipse	日食
stealth crater	隐形陨石坑
stereo camera	立体摄影机
striking dichotomy	截然分明的两部分
sublimation	升华作用
subsurface geology	地下地质结构
terrestrial glacier	地球上的冰川
The resemblance to Earth fell apart.	认为火星和地球相似的说法不攻自破。
tilt of Mars's rotation axis	火星自转轴的倾斜度
time of heavy cratering	陨石坑形成的多发期
topographical measurement	地形测量值
transmit radio signal	传输无线电信号
vestige	残余
viscous fluid	黏稠液体
volatile material	易挥发物质
volcanic flow	火山熔岩流
volcanoes that dwarf any on Earth	高于地球上任何一座火山的火山
weathered, quartz-rich soils, hydrated clays, and salts such as calcium carbonate and sulfate	富含石英的风化土壤、水合黏土，以及碳酸钙和硫酸盐等盐类物质

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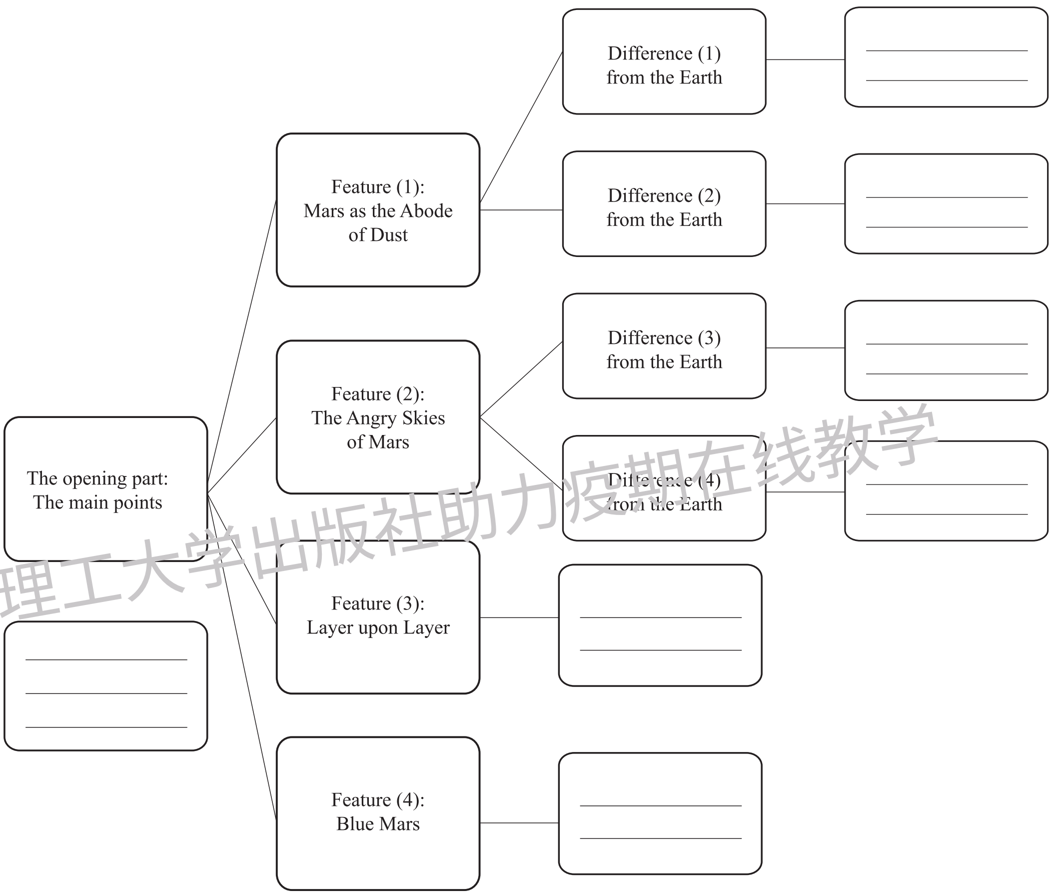
Task 2: Read the topic sentence and concluding sentence of each paragraph and complete the following diagram that reflects the General-Particulars discourse pattern of the article. Then determine the communicative purpose of the article and the rhetorical strategies to achieve the purpose.



The communicative purpose of the article:

____.

The rhetorical strategies to achieve the purpose:

____.

Text I

The Unearthly Landscapes of Mars: The Red Planet Is No Dead Planet[4]

Arden L. Albee

1 In science as well as science fiction, Mars is usually depicted as a version of Earth in its extreme—smaller, colder, drier, but sculpted by basically the same processes. Even well into the 20th century, many thought the planet had flowing water and **proliferating plants**. **The resemblance to Earth fell apart** when spacecraft in the late 1960s revealed a **barren**, **cratered world**, more like the moon. But it quickly returned with the subsequent discoveries of giant mountains, deep **canyons** and complex weather patterns. The Viking and Mars Pathfinder images from the surface look strangely Earth-like. Researchers compare the **equatorial regions** of Mars to the American Southwest. For the **polar regions**, the model is the Dry Valleys of Antarctica, a frozen desert in a landscape of endless ice.

2 But if there is one thing researchers have learned from recent Mars exploration, it is to be careful about drawing such comparisons. In the past five years, spacecraft have collected more information about the Red Planet than all previous missions combined. Mars has proved to be a very different and more complicated planet than scientists thought beforehand. Even the single biggest question—Was Mars once warm and wet, possibly **hospitable to the evolution of life**?—is more confused than people have tended to assume. To make sense of Mars, investigators cannot be blinded by their experience of Earth. The Red Planet is a unique place.

Mars as the Abode of Dust

3 Mars exploration has certainly had its ups and downs. In the past decade NASA has lost three spacecraft at Mars: Mars Observer, Mars Climate Orbiter (intended as a partial replacement for Mars Observer) and Mars Polar Lander. Lately, though, the program has had a run of successes. Mars Global Surveyor has been taking pictures and collecting **infrared spectra** and other data continuously since 1997. Another, Mars Odyssey, has been **orbiting the planet** for more than a year, mapping the water content of the subsurface and making **infrared images** of the surface.

4 Never before have scientists had such a comprehensive record of the processes that

operate on the surface and in the atmosphere. They have also studied the craters, canyons and volcanoes that are dramatic relics of the distant past. But there is a huge **gap in our knowledge**. Between ancient Mars and modern Mars are billions of missing years. No one is sure of the conditions and the processes that sculpted Mars during most of its history. Even less is known about the **subsurface geology**, which will have to be the subject of a future article.

5 Present-day Mars differs from Earth in a number of broad respects. First, it is enveloped in dust. Much of Earth's surface consists of soil mostly derived by **chemical weathering of the underlying bedrock.** But much of Mars's surface consists of dust—very fine grained material that has settled out of the atmosphere. It is thick even on the highest volcanoes.

6 Dust produces otherworldly landscapes, such as **distinctively pitted terrain**. As dust settles through the atmosphere, it traps **volatile material**, forming a **mantle of icy dust**. **Intriguingly**, the thickness of the icy, dusty mantle on Mars varies with latitude; near the poles, Mars Odyssey has shown, as much as 50 percent of the upper layer of soil may be ice. On slopes, the icy mantle shows signs of having flowed like a **viscous fluid**, much in the manner of a **terrestrial glacier**. This mantle is becoming the focus of **intense scientific scrutiny**.

7 Second, Mars is extremely windy. It is dominated by **aeolian activity** in much the way that Earth is dominated by the action of liquid water. Spacecraft have seen globe-encircling **dust storms,** huge **dust devils** and **dust avalanches**—all wrought by the wind.

8 Where not dust-covered, the surface commonly shows **aeolian erosion or deposition**. Evidence for erosion shows up in craters, from which material appears to have been removed by wind, and in bedrock features that clearly have been carved by windblown sand. Evidence for deposition includes **sand sheets** and moving **sand dunes**. The latter are composed of sand-size grains. Aeolian activity seems to have persisted since the **time of heavy cratering**, back when the solar system was still young. Many images show craters with varying degrees of erosion: Some are shallow and partially filled with deposits and sand dunes, whereas others are **pristine**—deeper and bowl-shaped. Michael Malin and Kenneth Edgett of Malin Space Science Systems in San Diego, the research firm that operates the Mars Global Surveyor camera, have inferred a sequence of processes: Sand was blown through the region, and some of it got trapped in craters; other craters formed later. Where and how such a volume of sand was produced and how it was blown around remain a mystery, however.

The Angry Skies of Mars

9 A third way in which Mars differs from Earth is in its amazing variety of weather and climate cycles, many of which are similar to those on Earth, many like nothing on Earth. The Martian day is almost the same as an Earth day, but the Martian year is 687 Earth days. The **tilt of Mars's rotation axis**, which produces seasons, is very close to that of Earth's. Mars lacks the **precipitation** and oceans that are so crucial to weather on Earth. But the **atmospheric pressure** (less than 1 percent of that on Earth) varies seasonally by about 25 percent, driven by the **condensation** and **sublimation** of carbon dioxide frost at the poles. The thin atmosphere has a very low heat capacity, so the surface temperature swings by more than 100 degrees Celsius from day to night. The thermal properties of the thin atmosphere are dramatically affected by dust and ice particles suspended in the air. The upshot is that, despite being so thin, the atmosphere has complex circulation patterns and dynamics. A daily weather report might talk of strong winds, high-level ice clouds, low-level fogs, seasonal frost, dust devils and massive dust storms.

10 As on Earth, storm systems often spiral southward from the northern polar regions. But the largest dust storms typically start during the southern spring as the planet rapidly heats up. Periodically they come together and encircle the entire planet. Mars Global Surveyor closely followed the evolution of a four-month global dust storm that started in June 2001. Contrary to scientists' expectations, it was not, in fact, one single global storm, but the **confluence** of several regional storms. Malin has compared the climatic effect of the dust raised by this storm with the **aftermath** of Mount Pinatubo's eruption on Earth in 1991—namely, a brief but widespread cooling.

11 The **polar ice caps** play a key role in the **atmospheric cycles**. Their size and shape, as shown by **topographical measurements**, indicate that the caps are predominantly water ice, as opposed to so called dry ice, made of carbon dioxide: Dry ice is not as rigid as water ice, and it could not support the observed domelike shape. A major new discovery has been that the layer of dry ice that covers much of the south polar cap is being eroded away at a high rate. Clearly, the erosion cannot go on forever. Nor can the current dust sinks and sources remain in their current states indefinitely. To replenish the ice and dust, other cycles must be occurring, perhaps tied to orbital variations. Malin and Edgett have suggested that wind condition may be less intense now than in the fairly recent past, another hint that the Martian climate changes with time.

12 A fourth major difference between Earth and Mars is the behavior of liquid water. Liquid water is unstable at the surface under present pressure and temperature conditions. It

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does not rain. Still, water ice can—and does—persist at some depth within the Martian soil during all or much of the year. On Mars, as on Earth, several types of patterned ground mark the presence of ice-rich soil. Mars Odyssey has detected ground ice over most of the planet outside the equatorial regions, and models predict that the ice extends to considerable depths.

13 Liquid water can sometimes leak onto the surface. In 2000 Malin and Edgett described fresh **gullies** that look like water carved features on Earth. In the ensuing excitement, researchers advanced many theories to explain them: Leaking **aquifers**; pressurized **geysers** of water; high-pressure outbursts of carbon dioxide gas; volcanic heat sources at depth. Finally, earlier this year Philip Christensen of Arizona State University discovered **gullies** that clearly emerge from underneath **a bank of snow and ice**. He concluded that they are related to Martian climate cycles. In colder periods, slopes become **blanketed with a mixture of snow and dust**. Sunlight penetrates this blanket, heating it enough for water to melt under the snow and to run down the slope, creating gullies. In warmer periods, the blanket melts or evaporates entirely, exposing the gullies.

Layer upon Layer

14 Despite the abundance of water, however, Mars is arid. It has the **mineralogy** of a nearly waterless surface. On Earth, the action of warm liquid water produces **weathered, quartz-rich soils, hydrated clays, and salts such as calcium carbonate and sulfate**. Beach sand and sand dunes are largely quartz. On Mars, spacecraft have yet to find any deposits of these minerals. The darker Martian dunes are **basaltic**, consisting mainly of minerals which on Earth would readily weather away. It follows that the present cold and dry atmospheric conditions have persisted since a time far back into the planet's history.

15 Has Mars always differed so much from Earth? Below the mantles of dust and sand are numerous signs that the Red Planet has transformed over time. To begin with, the planet has a **striking dichotomy** in the landscape between its northern and southern hemispheres. The southern hemisphere is **high in altitude** and heavily cratered (indicating an ancient surface). The northern one is a vast, low-lying plain with fewer craters (indicating a younger age). In between is the immense Tharsis Plateau, intermediate in age and capped by **volcanoes that dwarf any on Earth**. Using the new **high-resolution images** on these volcanoes, James W. Head of Brown University has found flow patterns that look strikingly like mountain glaciers—and that may suggest the presence of ice under a blanket of rock and dust.

16 The northern lowlands are exceedingly level, leading to the speculation that they were

lake beds during a significant chunk of Martian history. They appear to be covered with multiple layers of **volcanic flows** and **sedimentary debris** that originated in the south. Detailed new topographic maps have unveiled "**stealth craters**"—faint circular expressions, evidently part of an ancient cratered surface that has been buried by a thin layer of younger deposits.

17 Along the edge of the southern highlands are the features that could only have been carved by liquid water. These features are tremendously larger than their counterparts on Earth. The famous canyon Valles Marineris would run from Los Angeles to New York with a width extending from New York to Boston and a depth similar to the elevation of Mount McKinley. No terrestrial canyon comes close. At its head is a jumbled terrain, indicating that water flowed not in a steady trickle but in concentrated, catastrophic outflows, scouring the surface along its path. Other Martian outflow channels have similar features. Because these features are carved into the Tharsis Plateau, they must have an intermediate age.

18 Streamlined islands and other features in these channels look much like **scablands** in the northwestern U.S., which were gouged by the Spokane Flood toward the end of the last ice age, about 10,000 years ago. During the massive **deluge**, a lake roughly the size of one of the Great Lakes burst its ice dam and rushed out within just a few days. On Mars, such calamities were 10 to 100 times as devastating. They may have been triggered by volcanic heat sources or by the general heat flow from the interior of the planet. Heat would have melted ice underneath the thick **permafrost layer** building up tremendous pressures until the water finally burst out.

19 The most contentious water-related features of all are the valley networks. Located throughout the southern highlands, they have a branching pattern **reminiscent of** rivers on Earth—suggesting that they were **formed by surface runoff from rainfall or snowfall**. They are the strongest hint that Mars was once as warm as Earth. But these networks look rather different from rain-fed rivers on Earth. They more closely resemble river networks in desert areas, which are fed by water that slowly seeps from subterranean sources. Heated debates have been taking place at scientific meetings over the crucial question: Did it rain on early Mars?

20 The timing of the water networks could be the key to making sense of them. The recent detailed studies of the northern edge of the highlands show that immense amounts of material eroded during—rather than after—the **intense meteor bombardment** that took place early in Martian history. These analyses imply that the distribution of water kept changing as **impacts reworked the landscape**. Craters filled with water and debris, and

channels began to link them together into a network, but impacts continually disrupted this process. For instance, the Argyre Basin, 1,000 kilometers in diameter, may once have been filled to its brim with water. It is part of a valley system that brought water from near the South Pole, through the basin, into the channels that crossed the equator. The roles of water and ice in these systems, both aboveground and underground, remain unclear. In any case, these networks are very different from the hydrologic systems on Earth.

21 A final clue to Martian history comes from one of the biggest surprises delivered by Mars Global Surveyor, the extent to which the uppermost crust consists of layered deposits. Almost everywhere that the subsurface is exposed—on walls of canyons, craters, and valleys—it is layered. The layers differ from one another in thickness, color and strength. They show that the Martian surface has undergone complex sequences of deposition, crater formation and erosion. The oldest layers are the most extensive. The higher layers have been partially stripped away, apparently blown by the wind.

22 Where did the layers come from? The lack of boulder like blocks argues against their being volcanic flows, although they could be volcanic ash. Ultimately, however, most of the layers probably originated in impact debris. On the moon, scientists observe the overlapping rings of impact debris, which mark craters of differing ages. Similarly, Mars is so heavily cratered that the upper crust has been stirred up like the soil tilled by a gardener. Water and wind then scattered this material.

Blue Mars?

23 In a sense, scientists' ideas about early Mars are more uncertain than they have ever been. This doubt **comes to the fore** when researchers address the question of liquid water. The presence or absence of liquid water is fundamental to geologic processes, climate change and the origin of life. The early valley networks and the later flood channels **attest to an abundance of water**. The evidence for early rainfall suggests that the atmosphere was once much denser. But spacecraft have found no evidence for the deposits of carbonate minerals, which would be the **vestige** expected from an early dense carbon dioxide atmosphere.

24 At this point, scientists have three main hypotheses. Perhaps the early atmosphere was indeed thick. The planet might have had lakes, even oceans, free of ice. Robert A. Craddock of the National Air and Space Museum and Alan D. Howard of the University of Virginia recently suggested that the carbon dioxide was lost to space or locked up in

the carbonate minerals that have so far escaped detection. Intriguingly, Mars Odyssey spectra have revealed small amounts of carbonate in the dust.

25 Alternatively, perhaps Mars had a fairly thin atmosphere. It was a wintry world. Any standing bodies of water were covered in ice. Snow might have fallen, **recharging the groundwater** and leading to the temporary trickles of water across the surface. Steven M. Clifford of the Lunar and Planetary Science Institute in Houston, among others, has **conjectured** that melting under a glacier or a thick layer of permafrost could also have recharged subterranean water sources. Although Mars was bitterly cold, periodic bursts of relatively warmer temperatures could have reinvigorated the planet. Orbital shifts, similar to those that trigger ice ages on Earth, drove these climate cycles. Head, John F. Mustard of Brown and others have pointed to the latitude dependence of the ice and dust cover as evidence for climate change.

26 Finally, perhaps the climate cycles were insufficient to make Mars warm enough to sustain liquid waters. The planet had warm conditions for only brief periods after major impacts. Each such impact deposited water-rich material and pumped enough heat and water into the atmosphere to permit rain. Soon, though, the planet returned to its usual frozen state. Victor Baker of the University of Arizona has argued that the **intensive volcanism** in the Tharsis region periodically made early Mars quite a temperate place.

27 It is also very possible that none of these options is correct. We simply do not yet know enough about early Mars to have any real understanding of its climate. We must wait for future exploration. Unlike Earth, Mars has preserved much of its ancient landscape, which may yield clues to the conditions under which it formed. Indeed, understanding how Mars became so different from Earth will help geologists **grapple with Earth's own history**. The new missions will soon provide some of these clues.

Task 3: Note down the similarities and differences between Mars and the Earth described in paragraphs 3-14. Give an oral summary with the help of your notes. Use words, expressions and structures to indicate or express the similarities and differences. Note that some of the comparisons are explicitly stated. Others are implied. For example:

- Much of Earth's surface consists of soil mostly derived by chemical weathering of the underlying bedrock. <u>But</u> much of Mars's surface consists of dust. (The difference is explicitly stated.)
- <u>As on Earth,</u> storm systems often spiral southward from the northern polar regions. (The

similarity is explicitly stated.)

- A third way in which Mars differs from Earth is in its amazing variety of weather and climate cycles, many of which are similar to those on Earth, many like nothing on Earth. (The similarities and differences are explicitly stated.)
- The Martian year is 687 Earth days. (The difference is implied.)
- Mars lacks the precipitation and oceans on Earth. (The difference is implied.)

Similarities:

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Differences:

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Task 4: Read the "Layer upon Layer" section and determine which of the following statements about Mars are considered to be known facts and which are the inferences from the known facts. Explain what language features help you distinguish inferences from facts.

1) The darker Martian dunes are basaltic, consisting mainly of minerals which on Earth would readily weather away. (Para. 14)
2) It follows that the present cold and dry atmospheric conditions have persisted since a time far back into the planet's history. (Para. 14)
3) To begin with, the planet has a striking dichotomy in landscape between its northern and southern hemispheres. The southern hemisphere is high in altitude and heavily cratered. The northern one is a vast, low-lying plain with fewer craters. (Para. 15)
4) The northern lowlands are exceedingly level, leading to the speculation that they were lake beds during a significant chunk of Martian history. (Para. 16)

5) Along the edge of the southern highlands are the features that could only have been carved by liquid water. (Para. 17)
6) Because these features are carved into the Tharsis Plateau, they must have an intermediate age. (Para. 17)
7) During the massive deluge, a lake roughly the size of one of the Great Lakes burst its ice dam and rushed out within just a few days. (Para. 18)
8) On Mars, such calamities were 10 to 100 times as devastating. (Para. 18)
9) They may have been triggered by volcanic heat sources or by the general heat flow from the interior of the planet. (Para. 18)
10) Heat would have melted ice underneath the thick permafrost layer, building up tremendous pressures until the water finally burst out. (Para. 18)
11) Located throughout the southern highlands, they have a branching pattern reminiscent of rivers on Earth—suggesting that they were formed by surface runoff from rainfall or snowfall. They are the strongest hint that Mars was once as warm as Earth. (Para. 19)
12) But these networks look rather different from rain-fed rivers on Earth. They more closely resemble river networks in desert areas, which are fed by water that slowly seeps from subterranean sources. (Para. 19)
13) The recent detailed studies of the northern edge of the highlands show that immense amounts of material eroded during—rather than after—the intense meteor bombardment that took place early in Martian history. (Para. 20)
14) These analyses imply that the distribution of water kept changing as impacts reworked the landscape. (Para. 20)
15) For instance, the Argyre Basin, 1,000 kilometers in diameter, may once have been filled to its brim with water. (Para. 20)
16) Almost everywhere that the subsurface is exposed—on walls of canyons, craters, mesas and valleys—it is layered. The layers differ from one another in thickness, color and strength. (Para. 21)
17) They show that the Martian surface has undergone complex sequences of deposition, crater formation and erosion. (Para. 21)
18) The oldest layers are the most extensive. (Para. 21)
19) The lack of boulder like blocks argues against their being volcanic flows, although they could be volcanic ash. (Para. 22)
20) Ultimately, however, most of the layers probably originated in impact debris. (Para. 22)

Language features to distinguish inferences from facts:

- ______________________________
- ______________________________
- ______________________________
- ______________________________

Task 5: Identify the hypotheses in the "Blue Mars" section about liquid water on Mars and explain the language features to indicate a hypothesis.

Note: Drawing inferences is the act of reasoning from factual knowledge or evidence, while framing hypotheses means providing a tentative explanation that needs to be tested by further investigation.

Hypothesis 1: ______________________________

____

Hypothesis 2: ______________________________

____

Hypothesis 3: ______________________________

____

Task 6: Determine whether the author is certain or uncertain about the information in the following statements.

Note: When the information is presented on the basis of reasoning, the author may use *hedge*s, i.e. words, expressions, and clauses to express uncertainty or avoid complete commitment. On the other hand, when the author wants to express certainty about the information presented, he/she may use *boosters*. For example:

- Malin and Edgett have suggested that wind condition may be less intense now than in the fairly recent past, another hint that the Martian climate changes with time. (hedges, uncertain)
- Perhaps the absence of larger rocks can be explained by the high concentration of condensed volatiles (such as water ice) in the subsurface that were affected by the Heimdall impact: A violent explosion would have removed and crushed the rocks that may have been at the landing site initially. (hedges, uncertain)
- Mars has proved to be a very different and more complicated planet than scientists thought beforehand. (booster, certain)
- Evidence for erosion shows up in craters, from which material appears to have been removed by wind, and in bedrock features that clearly have been carved by windblown sand. (In this sentence, *appears to* is a hedge while *clearly* is a *booster*, meaning that the

first chunk of information is not very certain, but the latter chunk of information is certain.)

1) Their size and shape, as shown by topographical measurements, indicate that the caps are predominantly water ice, as opposed to so called dry ice, made of carbon dioxide.
2) Finally, earlier this year Philip Christensen of Arizona State University discovered gullies that clearly emerge from underneath a bank of snow and ice.
3) Along the edge of the southern highlands are the features that could only have been carved by liquid water.
4) The timing of the water networks could be the key to making sense of them.
5) The lack of boulder like blocks argues against their being volcanic flows, although they could be volcanic ash.
6) Steven M. Clifford of the Lunar and Planetary Science Institute in Houston, among others, has conjectured that melting under a glacier or a thick layer of permafrost could also have recharged subterranean water sources.
7) Although Mars was bitterly cold, periodic bursts of relatively warmer temperatures could have reinvigorated the planet.
8) A daily weather report might talk of strong winds, high-level ice clouds, low-level fogs, seasonal frost, dust devils and massive dust storms.
9) The planet might have had lakes, even oceans, free of ice.
10) Snow might have fallen, recharging the groundwater and leading to temporary trickles of water across the surface.
11) They appear to be covered with multiple layers of volcanic flows and sedimentary debris that originated in the south.
12) Aeolian activity seems to have persisted since the time of heavy cratering, back when the solar system was still young.
13) So the absence of this gas therefore proves the absence of magnesium sulfate in the soil.
14) Clearly, the erosion cannot go on forever.
15) Ultimately, however, most of the layers probably originated in impact debris.
16) Because these features are carved into the Tharsis Plateau, they must have an intermediate age.
17) All these facts taken together point toward the likely presence of calcium carbonate in the soils that Phoenix has analyzed.

***Task 7:* Explain how the following nouns are formed and what they refer to. Note that the nouns formed from verbs may indicate a natural, geological process, a state/condition, or a result from an action. Some words may have more than one meaning.**

Example:

"erosion" can mean the process and act of eroding, the result of the process, or the state of being eroded.

1) circulation (pattern): ____________________

2) condensation (of carbon dioxide frost): ____________________

3) cratering: ____________________

4) deposition: ____________________

5) evaporation: ____________________

6) exposure: ____________________

7) (faint circular) expression: ____________________

8) (topographical) measurement: ____________________

9) (sunlight) penetration: ____________________

10) precipitation: ____________________

11) resemblance: ____________________

12) sublimation: ____________________

13) (orbital) variation: ____________________

14) (chemical) weathering: ____________________

***Task 8:* Write an essay which summarizes the striking features of Mars. You can use the General-Particulars discourse pattern and the comparison and contrast strategy in your writing.**

Note: There are two common ways to organize a comparison and/or contrast. One is known as *block comparison*. For example, when comparing Mars and the Earth, you can examine all the features of Mars first and then all the features of the Earth. The other common way of organizing a comparison is called *point by point comparison*, in which the features of Mars and the Earth are compared one by one. The latter method is used in this article.

Task 9: Work in groups and list what scientists know and what they are uncertain about Mars.

What scientists know about Mars	What scientists are uncertain about Mars
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________

Task 10: Write an essay to analyze the early history of Mars on the basis of scientific evidence from Mars missions so far. You can focus on the following points. Use hedges or boosters when necessary.

- Summarize scientists' hypotheses about the presence of liquid water on early Mars.
- Suppose scientists' hypotheses are reliable, draw inferences about the early history of Mars, and then make hypotheses about what might have happened later.

Task 11: Discuss the following questions on the basis of the information in Text II.

1) Should the public support space exploration? Why?
2) What do you learn from Phaethon's tragedy?
3) What do you think of the choral "Ode to Man" cited from Sophocles' tragedy *Antigone*? (Note that this ode celebrates the "wonder" of man. It begins on an optimistic note by praising man for being able to accomplish whatever goal he sets his sights on—crossing the sea in winter, snaring birds and beasts, taming wild horses. But the point of the ode is that while man may be able to *master* nature by developing techniques to achieve his goals, man should formulate those goals by taking into consideration the common good. Otherwise, man becomes a monster.)
4) Do you agree that the power of science and technology can be compared with the power of

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the fiery chariot of Apollo?

5) What do you think of the two admonitions: “Nothing in excess” and “Know thyself”?

Text II

The space age began fifty years ago with the launch of Sputnik, the first artificial satellite, on October 4, 1957. It was a great technical and political triumph for the Soviet Union. In the United States, the immediate reaction was a swift and harsh self-assessment marked by very public fretting about a “technology gap.” But a dozen years later, at the climax of the space race, the first men on the Moon were Americans. In the decades since, the civilian space program has largely receded from public attention—even as space has become indispensable to the military and the high-tech industry, and as a promising new private space sector is just taking shape.

To mark the Sputnik anniversary—and with it, the beginning of the space age—we have reprinted Hannah Arendt’s classic 1963 essay about modern science and the human meaning of our celestial aspirations, and invited five commentators to respond to her argument and to discuss its relevance today: Patrick J. Deneen, Rita Koganzon, Charles T. Rubin, Stephen Bertman (below) and Peter Augustine Lawler.

Chariots in the Sky[5]

Stephen Bertman

1 Until men walked upon it in 1969, the Moon had always marked the first of those **celestial limits that earth-bound humans could not transgress**, limits separating what man **for eons** had regarded as the **sacred realm of the gods** and even modern man could only gaze at in wonder. With the lunar landing, however, human beings for the first time set foot on heavenly soil and, planting a flag, claimed it for mankind.

2 Nine years earlier, spurred on by advances in Soviet rocketry, the Eisenhower administration had already speculated on the possibility of sending American astronauts to the Moon. Under the leadership of Abe Silverstein, director of NASA’s Office of Space Flight Programs, the mission was dubbed the “Apollo program,” named for the ancient Greek god of the sun because, in Silverstein’s words, “the image of the god Apollo riding his **chariot** across the sun gave the best representation of the grand scale of the proposed program.”

3 With the election of John F. Kennedy, the Apollo program was given decisive impetus. In

a 1961 message to Congress, President Kennedy announced the national goal of putting a man on the Moon before the decade was out—"the most hazardous and dangerous and greatest adventure on which man has ever embarked." Under his inspiring leadership, space would become "the edge of a New Frontier," supplanting the terrestrial frontier of our nation's westward expansion. Unlike that earlier frontier, the new frontier of space would point to a horizon infinite in extent.

4 The choice of Apollo's name for the program was tinged with irony. Apollo's most famous temple in Greece was located at Delphi. There for countless generations Apollo's priestesses had prophesied the future by drawing upon the god's **oracular powers**. Carved in marble above the temple's entranceway were words of wisdom intended as cautions to the faithful. Most prominent among them were "Nothing in excess" and "Know thyself."

5 The first of these two **admonitions** warned visitors about the danger of going to extremes. A life of moderation is best, the ancient sages taught, because it avoids the harmful consequences of excess. The second warning, for its part, cautioned people to be mindful of their human limitations, lest they be destroyed by overreaching. Taken together, the two admonitions constituted a prescription for averting tragedy, both personal and national.

6 According to mythology, such personal tragedy was visited upon Apollo's own son, Phaethon. Phaethon's mother had repeatedly told him he had been fathered by none other than the god Apollo, but the lad harbored doubts. So Phaethon traveled eastward to the horizon where, at dawn, Apollo yoked the team of horses that drew his solar chariot across the sky. "If indeed you are my father," Phaethon said, "then grant me any wish." "Of course, my son," Apollo gladly replied. "Then I choose to drive your chariot across the sky," the young man proclaimed. Knowing the danger of entrusting the reins of his fiery team to young and inexperienced hands, the horrified god begged his son to reconsider. But the promise had been made, and Phaethon, refusing to relent, mounted the golden chariot.

7 At first the team bolted from its chute as always, climbing upwards to the heavens on its customary track. But sensing the loose hold their inexperienced driver had upon the reins, the horses broke free, diving toward the surface of the earth with the blazing sun in their train. Observing this from the heights of Mount Olympus, Zeus, king of the gods, took action. To save the earth from incineration, he hurled his thunderbolt at the runaway chariot, striking Phaethon and sending him plunging to his death.

8 Phaethon's youthful enthusiasm had blinded him to his inexperience. Failing to

acknowledge his limitations tragically cost him his life.

9 Tragedy was something with which the Greeks were intimately familiar, for, like Phaethon, they were an emotionally-charged people driven by a passion to achieve and often paid a high price for their ambitions. Lovers of freedom, they frequently failed to anticipate the destructive consequences of their impulsive choices. The true causes of tragedy, their storytellers repeatedly reminded them, lie not outside ourselves but within. We are most vulnerable, they taught, not when we are weak but when we are strong, for when we are strong, we can become drunk with power and commit acts of hubris that are irreversible.

10 Sophocles dramatized this propensity in his tragedy *Antigone*. In an ode that celebrated humanity's **astounding creative powers**, he simultaneously pointed to man's penchant for destruction:

Many are the world's wonders, but none more wondrous than man.
Under the south wind's gale, he traverses the gray sea,
knifing through its surging swells.
Earth, eldest of the gods, imperishable and everlasting,
he erodes year after year with winding furrows
cut by his equine team.
The winged flocks of birds,
the wild herds of beasts,
and the salt-sea schools of fish
he entraps in the woven mesh of his devious net.
With his devices he overpowers the creatures of the wild,
reining in the shaggy-maned stallion
and yoking the stubborn mountain bull.
Speech he developed and wind-swift thought
and the talent to dwell together, and learned
how to evade the chilling frost and pelting rain.
Ingenious, there is nothing that comes that he cannot master;
only from Death can he not contrive an escape.
With a brilliance and subtlety beyond imagining
he gravitates at times toward evil, at other times toward good.

11 Hannah Arendt understood that, while technology might apply scientific discoveries to human use, science *per se* was unconstrained by any consideration for the good of mankind because the concerns of the scientist, including those of the space scientist, are

different from those of the humanist. The concerns of the former are physical and objective; of the latter, spiritual and subjective. Scientists express their findings through abstract mathematics; humanists, through words and images based on sensory and emotional experience. And most importantly, while the humanities are **preoccupied with** moral and ethical considerations, science and technology in their purest form know no such limits.

12 Viewed in this light, the landing on the Moon is symbolic of a profound change in human history, the dissolution of historic limitations, a tendency intrinsic to the two forces, science and technology, that have gone on to become the dominant forces governing Western civilization in these days of the waning influence of traditional ethics and morality. Indeed, so great is their power and so awesome their destructive potential that they can rightly be compared with the fiery chariot of Apollo.

13 Yet, as we have seen, that chariot was only as good as the hands that held its reins. President Kennedy made much the same point when he described the moral challenge space exploration would present. "Space science," he said in his Rice University address in 1962, "like nuclear science *and all technology*, has no conscience of its own. Whether it will become a force for good or ill depends on man." By **sating our voracious curiosity** and multiplying the primal force of our will, science and technology together—like Apollo's spirited team—tempt us to fulfill our grandest ambitions by acting on our impulses, however blind we may be to the long-term consequences of their exercise.

14 The dramatic effects of these two forces can be seen by examining the ways in which they have transformed our perceptions of time and space.

15 The Industrial Revolution quickened the pace of everyday life; the Electronic Revolution has accelerated it even further. Unlike the slower mechanical devices of yesteryear, the newer electronic technologies that we now depend upon for our existence operate at nearly the speed of light, infusing our lives with artificial urgency and unremitting stress. To our detriment we have, in Thoreau's words, become "the tools of our tools." While delivering overwhelming quantities of data, electronic communications demand that we respond rapidly with quick decisions, but simultaneously deny us the precious time we need for thoughtful reflection. Meanwhile, a global entertainment industry cultivates our impulses by instantly gratifying our desires while tempting us to desire even more. Dazzled by rapid-fire stimuli and captivated by glittering trivia, we lose sight of the critical facts and enduring truths they obscure.

16 Those stimuli and trivia are generated by the commercial interests profiting from our

distraction by feeding our appetites in limitless ways. By making the acquisition and possession of material goods and the enjoyment of sensory pleasure the center of our existence, materialism continues to alter the landscape of our lives. More and more, matter is displacing spirit. And while nature might otherwise constitute by its rhythms and autonomous existence a reminder that there is something more to life than what we can manufacture or buy, nature itself is being increasingly destroyed and displaced by a synthetic man-made environment. Like the demolition of historic buildings, the speed of nature's transformation serves to erase the very memory of an earlier time, even as the speed of social change distances us from the intellectual principles and spiritual values that once sustained us.

17 Some optimists see in the future a **grand convergence of** new scientific discoveries and technologies that will open the unlimited vistas of a Golden Age. Others more pessimistically fear that such a convergence may instead cause humanity to lose control and irrevocably cede its destiny to the machines, an event philosopher Jacques Ellul forecast over a half century ago in *The Technological Society*. These extreme visions reveal a shared truth: The future of mankind will ultimately depend upon what we do here on Earth, not what we do in outer space. Our stature as a race will only minimally be increased or diminished by the "greatest adventure" President Kennedy described long ago. In the end, it will mainly be determined not by whether we ride chariots into the heavens but whether we have the courage to know ourselves.

Task 12: Read Text III and note down the most important events in the history of space exploration around the world. Use your notes to give an oral summary.

Notes:

In 1955: ____

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In 1957: ____

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In 1961: ____

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In 1965: ____

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In 1969: ____

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In 1975: ____

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In 1990: ____

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In 1997: ____

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In 2003: ____

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In 2008: ____

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In 2011: ____

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In 2012: ____

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In 2013: ____

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Text III

Space Explorations Around the World[6]

1 Throughout human history, space has remained a distant realm full of mystery and wonder. From early star charts to the first telescopes, we have long been working towards new discoveries in space and discovering what lies beyond our planet, and perhaps one day revealing the secrets of the universe. Progress had been slow and steady for centuries until the Space Race in the 1950s, when space exploration became a competition between world powers, the United States and the Soviet Union.

2 The Space Race began in 1955, when both the USA and USSR announced plans to launch satellites, after taking control of German rocket technology post-WWII. In the wake of Cold War tensions, the announcement sparked a push for innovations and advances, with increased funding for research and education. The result has been the invention of many new and beneficial technologies that have changed the world, **culminating in** putting a man on the moon, and someday, beyond.

3 Ten countries have had successful **satellite launches** (independently, using their own launch vehicles): Soviet Union, US, France, Japan, China, UK, India, Israel, Iran, and North Korea.

Sputnik 1 (USSR)

4 In the first major event in the history of space exploration, the Space Race was initiated by the launch of Sputnik 1 (Satellite 1) by the USSR on October 4, 1957. Sputnik 1 was the world's first **artificial satellite**, as well as the first successful orbital launch. It was launched from the Kazakh SSR. The **unmanned satellite** was a metal sphere about the size of a beach ball, 58 centimeters (23 inches) in diameter, and weighing 83 kilograms (184 pounds). Sputnik 1 orbited Earth at 29,000 kilometers (18,000 miles) per hour, completing each orbit in about 96.2 minutes. The satellite **transmitted radio signals** back to Earth during its orbit. It completed 1,440 orbits around the Earth, traveling about 70 million kilometers (43.5 million miles) before **decaying** and burning upon reentry into the atmosphere on January 4, 1958.

5 Sputnik 1 was quickly followed with the launch of Sputnik 2, a month later, on November 3, 1957. Sputnik 2 was **notable** for having the first animal launched into orbit, with Laika the dog inside. The dog overheated and died within hours of takeoff. The successful launch of Sputnik 1 also spurred the United States to launch their own satellite, which happened on January 31, 1958.

Vostok 1 (USSR)

6 The next major step in space exploration history happened on April 12, 1961, with the first successful human spaceflight. The 27-year-old **cosmonaut** Yuri A. Gagarin of the USSR manned the Vostok 1 (meaning East 1) spacecraft, which orbited Earth once. The flight lasted 1 hour, 48 minutes, and traveled 320 kilometers (200 miles) above Earth. Gagarin made reports back to the ground station throughout his flight. After completing the orbit, the satellite was set to reenter the atmosphere, but it was not able to land at a safe speed. Instead, Gagarin was ejected from the craft about 7 kilometers above ground, his parachute deploying at about 2.5 kilometers (8,200 feet) above ground, and the Vostok 1 also landed with a parachute. Gagarin landed about 280 kilometers (174 miles) **off course** from the intended landing site, ending up in the Saratov region.

Voskhod 2 (USSR)

7 The Soviet spacecraft, Voskhod 2, was launched March 18, 1965, manned by Pavel Belyayev and Alexey Leonov. The spacecraft was in orbit around the Earth. The mission was important to the history of space exploration, as it was the first time a person moved out of the spacecraft and walked in space for 12 minutes, 9 seconds. Cosmonaut Leonov

wore a space suit and exited the Voskhod space craft via an **inflatable airlock**. Leonov was successful in his air walk, but pressure made his spacesuit too stiff to reenter the airlock until he was able to recover. There were also issues resealing the airlock, delays, and a spinout, but the voyage was otherwise successful.

Apollo 11 (USA)

8 One of the most famous space explorations in history was the first ever manned moon landing of the United States flight, Apollo 11, with astronauts Neil Armstrong, Buzz Aldrin, and Michael Collins on board. The aircraft was launched on July 16, 1969, from Meritt Island, Florida. The mission was to fulfill President Kennedy's promise to land a man on the moon by the end of the 1960s. The **lunar module** of Apollo 11 landed on the moon July 20, and Armstrong stepped out onto the surface of the moon on July 21, followed shortly afterward by Buzz Aldrin. Armstrong is famously quoted as describing it as "one small step for man, one giant leap for mankind," acknowledging the importance of the event. Michael Collins remained on the command module for the duration of the trip. The craft landed in the Sea of Tranquility and remained on the moon for over 21 hours. The astronauts remained outside the aircraft for about 2.5 hours. They collected material from the moon to bring back to Earth for research. They also left behind a US flag, a bag of memorabilia including a golden olive branch as a symbol of peace, as well as scientific technology. Apollo 11 returned to Earth, landing on July 24 in the Pacific Ocean. This landmark event was one of the most amazing space explorations in history, and effectively the end of the Space Race.

Apollo-Soyuz Test Project (USSR and USA)

9 The ultimate symbol of the end of the Space Race and the start of a truce between the USSR and the USA was the Apollo-Soyuz Test Project, the first joint flight of the two countries, in which cosmonauts met in space. The Apollo crew included Thomas Stafford, Vance Brand, and Donald Slayton, while the Soyuz crew were Alexey Leonov and Valeri Kubasov. The two flights launched on July 15, 1975, docking together on the 17th and separating after the mission was complete. Working together, Apollo helped partially block the sun, allowing the Soyuz to photograph the **corona** of the sun. Soyuz returned and landed on July 21, while Apollo returned on July 24. The mission was a success and important to show the cooperation of efforts between the two superpowers, as they moved past the competitive aspects of space exploration and focused on space exploration benefits.

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Hubble Space Telescope (USA)

10 Deployed on April 25, 1990, from Florida's Kennedy Space Center, the Hubble Space Telescope is a powerful telescope that orbits the Earth, observing the planet, taking images outside of the Earth's atmosphere, and making new discoveries in space. The telescope has an aperture measuring 2.4 meters (7.9 feet) and a focal length of 57.6 meters (189 feet). It is equipped with various instruments and cameras, including ultraviolet and infrared cameras, to transmit data back to Earth.

11 While the Hubble Space Telescope is not the first telescope launched into orbit, it is the only one that is serviced in space. It **is** also **noted for** being one of the largest space telescopes.

Loss of Space Shuttle Columbia (USA)

12 One of the NASA space explorations was the shuttle, Columbia, which was a successful and spaceworthy aircraft that completed 27 missions before it was destroyed during the last mission on February 1, 2003. The shuttle had been used to repair the Hubble Space Telescope, deploy commercial satellites, and especially for research purposes, like the microgravity spacelab. Its first mission was on April 12, 1981 from Edwards Air Force Base.

13 The final mission of the Columbia was launched on Jan 16, 2003, on research expedition for microgravity lab and Earth science studies. On board the Columbia during the mission were 7 crew members: Rick Husband, William McCool, Michael Anderson, David Brown, Kalpana Chawla, Laurel Clark, and Ilan Ramon. At the end of the 16 days of the final Columbia mission, the space shuttle had been punctured, and upon reentry into the atmosphere, the heat destroyed the integrity of the wing and the shuttle broke apart and disintegrated. The accident was a tragedy that resulted in the deaths of everyone on board, and brought to reality the disadvantages of space exploration.

Mars Rovers (USSR, USA, UK, India)

14 Once Earth's orbit and even the moon were conquered with space exploration, the next logical location for exploration was Mars. The first attempts to put a rover on Mars were the USSR's Mars 2 and 3, both in 1971, which failed upon landing and soon after landing. The first successful Mars rover landing was by the United States, with the Sojourner rover, Mars Pathfinder on July 4, 1997, which lost communications a few days after landing. The next attempt was the Beagle 2, launched by the British in 2003 as part

of the European Space Agency Mars Express mission. The mission failed 6 days before entry into the atmosphere of Mars.

15 This was followed by the successful US missions, Spirit and Opportunity in 2003, and Curiosity in 2011. Spirit was a successful rover for its first 6 years of operation, exploring 7.73 kilometers (4.8 miles) before getting stuck in 2009 and becoming a stationary observer until it lost contact in March 2010. Opportunity has been on Mars since January 25, 2004, and holds the record for the longest time on Mars, continuing today. Curiosity was launched November 26, 2011, landing August 6, 2012 in Mars' Gale Crater, and continues to explore the surface of Mars today. India's Mars Orbiter Mission, or Mangalyaan, was launched November 5, 2013, on a mission to Mars to advance Indian technology and to explore the surface of the planet. Mangalyaan is scheduled to reach the Mars orbit on September 24, 2014, and it reached its halfway point on April 11, 2014.

Chandrayaan-1 (India)

16 On October 22, 2008, the Indian Space Research Organization launched its first unmanned lunar space probe, a major event in the country's space program. Chandrayaan 1 was successfully placed into lunar orbit on November 8, deploying the Moon Impact Probe on the 14th, and landing on the moon, near the Shackleton crater. India became the fourth nation to place its flag on the moon, and collected soils in search of water. Though there were some technical issues, the mission was successful but cut short, lasting 312 days (instead of 2 years), but completing most of its missions. The end of the mission was August 28, 2009 when it returned to Earth.

SpaceShipOne (California, USA)

17 The first manned private spaceflight was developed by the aviation company, Mojave Aerospace Ventures as part of the Tier One program. The first ever test flight was on May 20, 2003, which was unmanned, and followed by two additional test flights. After receiving the appropriate licenses, a manned flight was scheduled to launch from the newly classified Mojave Air and Space Port in Southern California's Mojave Desert, which is a civilian aerospace test center. On June 21, 2004, SpaceShipOne launched Flight 15P, carrying the first civilian astronaut, Mike Melvill. The duration of the flight was just 24 minutes, reaching a height of 100,124 meters (328,491 feet), with just over 10 seconds of time past the boundary to space. There were some issues with the flight, which were later resolved, and the spacecraft was later entered into the competition for

the Ansari X Prize, which it won, along with a $10,000 award. SpaceShipOne marked an important milestone in the space travel timeline, and showcases the advancements of technology and the future of space exploration.

Yutu (China)

18 In one of the most recent space exploration missions, launched December 1, 2013, Yutu was China's first lunar rover, and the first moon rover since Russia ended operations in 1973. Yutu was part of China's Chang'e 3 mission, landing on the moon December 14, 2013, with the moon's first soft landing in 37 years. The rover landed off course on Mare Imbrium. The mission of Yutu was for China to explore the moon's topography and geology and study lunar soil down to 30 meters (98 feet) and even the crust, deep below the surface. Equipment on the rover included an **alpha particle x-ray spectrometer** and **infrared spectrometer** and **stereo cameras**. The Yutu rover has exceeded expectations for the duration of its exploration, though it has had various struggles, and it is still in limited use. It may witness the **solar eclipse** by the Earth from the moon's surface.

SpaceX (California, USA)

19 One of the most promising endeavors in the future of space exploration and private space travel is the California-based Space Exploration Technologies Corporation, known as SpaceX. Headed by Elon Musk, CEO of Tesla and remarkable innovator, the program is working toward a mission of one day colonizing Mars. The group was established in 2002, and has developed several spacecraft, including the Falcon 1 and 9, and the Dragon. The projects of SpaceX have included the development of rocket engines and orbiting satellites, with a focus on lowering costs of development, making it more accessible to private parties. SpaceX also works with NASA as a contractor, conducting missions for the International Space Station, as well as work for the US military. The Red Dragon project is scheduled to be completed in 2018, and would be a research mission looking for water and proof of life on Mars. The company's future projects include liquid-methane-based rocket engines, spacecraft for Mars landings, and eventually human voyages to Mars, opening the door for amazing space explorations accessible to everyone.

Task 13: Complete the following news report with the words or word chunks you hear.

Christmas 2003 was bittersweet for Mars scientists. Because one gift they (1) _________ wanted never arrived: The British-built spacecraft Beagle 2 was (2) ________________ to land on the Red Plant, radio home the good news and begin a (3) ________________. Instead, mission controllers heard nothing. They finally declared the Beagle 2 lost after months of silence. Many space scientists thought it crash-landed or broke up in the thin (4) ________________.

But now Beagle 2's final resting place has been found. New images from NASA's Mars Reconnaissance Orbiter revealed the spacecraft in its intended landing region, a massive (5) ________________ basin near the Martian equator.

The two-meter-wide lander is little more than a low-resolution lump of pixels in the images. But investigators gathered enough information to (6) ________________ what probably went wrong: the probe's (7) ________________ seem to have only partially deployed, throttling Beagle 2's power and preventing it from phoning home. Without contact with (8) ________________, the probe was doomed to a slow demise before it could perform any science.

Nevertheless, the lander appears intact, and the remains of a parachute and an atmospheric-entry cover lie hundreds of meters away. Beagle 2 may now be considered a (9) ________________, delivering the United Kingdom a very late Christmas gift: The nation's first (10) ________________ on another planet.

Task 14: Answer the following questions briefly based on what you watch about Mars.

1) Why is Mars a cold planet?

____

2) Why does Mars have a hard time holding the heat it gets?

____

3) How easily does the heat from the Sun escape?

____

4) What are the temperatures at night on Mars?

____

Task 15: Answer the following questions according to a report about Curiosity rover on Mars.

1) How many samples were collected this week?

____

2) How was the sample collected?

____

3) What is the color of the sample material?

____

4) For what purpose was the sample collected?

____

5) What is the location of the sample?

____

Task 16: Answer the following questions about NASA's commercial crew program according to Tom Simon.

1) What is NASA's commercial crew program and how is it different from other human spaceflight programs?

____

____

2) What is the goal of NASA's commercial crew program?

____

____

3) What is going on aboard the space station?

____

____

4) What is the purpose of certifying commercial systems for NASA's use?

____

____

5) Will the certification approach work effectively according to Tom Simon?

____

____

6) What does Tom Simon see as the primary benefits of the commercial crew program?

____

____

Task 17:* *Note down the main points about the Thanksgiving food for the astronauts in the international space station.

1) Food available:

____

____

2) The roles of the three NASA food scientists:

____

____

3) Food processing requirement:

____

____

4) Psychological aspect of food:

____

____

Task 18:* *Complete the following statement which summarizes the main idea of the video you watch.

LRO scientists usually use lasers to ______________________________________,
but in the future, they will use lasers to ____________________________________.

Task 19:* *Listen to a program about Curiosity's mission and note down the main points.

1) NASA technicians' feeling when the robot landed on Mars:

____

____

2) The location of Curiosity's landing:

____

____

3) Curiosity's mission:

____

____

4) Evidence found by Curiosity:

____

____

5) The reason why water simultaneously boils and freezes:

____

____

6) People's assumption in the 1960s about Mars:

____

____

7) The finding of Marina 4:

____

____

8) The finding of Marina 9:

____

____

Task 20: Go to http://www.nasa.gov/ and http://www.spacechina.com/ to find the latest information about space exploration.

Unit 3

Clean Energy

Objectives

- Acquaint yourselves with the Problem-Solution discourse pattern in text construction;
- Understand the communicative purpose of an argumentative article and the rhetorical strategies to achieve the purpose;
- Explain the chain effects of a rapid rise in energy prices;
- Explain the advantages and disadvantages of different energy sources;
- Distinguish positive evaluation from negative evaluation of different energy sources;
- Recognize attitude markers for giving evaluation;
- Distinguish claims, arguments, and evidence from one other;
- Identify strategies to present arguments in a debate on a controversial issue;
- Propose and discuss potential solutions to energy shortage problems;
- Note down the main points when listening to talks and interviews about energy sources.

Task 1: Familiarize yourselves with the following new words, set expressions or lexical chunks to prepare for reading the texts in this unit.

a myriad of global organizations	很多国际组织
aggressive push toward green power	对绿色能源发展的积极推进
ameliorated	得到改善的
ancillary non-recyclable material	不可循环使用的辅料
antiquated	陈旧的
archaic transmission system	陈旧的传输系统
belie	与……不相符
blow in the wind	随风飘逝
capacity factor	利用率
capricious energy source	不可靠的能源
cast serious doubt on	对……产生严重怀疑

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continued

cellulosic ethanol feedstock	纤维素乙醇原料
commercially viable	具有商业利益的
contend with	应对，与……做斗争
convene a panel	召集专家组
cost-push inflation	成本增加引起的通货膨胀
curry favor with	讨好
diesel fuel	柴油
electricity grid	电力网
energy intensive industry energy-intensive supplier	高能耗产业 高耗能供应商
enmesh themselves in	使自己陷入
epiphany	顿悟
ethanol mandate	乙醇政策
exacerbate	使恶化
ferment	发酵
fertilizer runoff	化肥残留物的流失
flavors of the month	风靡一时之事物
fraught with thorny economic issues	充满棘手的经济问题
give some respite to the market	给市场喘息的机会
hype fail to live up to the hype	大肆宣传，大肆炒作 辜负了炒作，没有宣传的那么好
intermittency problem	间歇性问题
in the right ballpark	大概是正确的
intrepid scientist	无畏的科学家
meltdown	崩溃
millennia millennium	几千年 一千年
monopoly	垄断
nitrous oxide	一氧化二氮
nuclear energy trumps wind power	核能胜过风能
offset the green job gains	与获得的绿色岗位相抵消
optimal region for wind turbines	使用风力涡轮机的最佳区域
panhandle	狭长地带

continued

pare consumption	削减消费
poster child	典型代表
power outage	断电
prohibitive cost	昂贵的成本
province of government-backed efforts	属于政府支持的领域
pumped storage	抽水蓄能
radioactive waste	放射性废料
ramification	衍生物，后果
remedy the problem	对此问题找出补救办法
rolling blackout	轮流停电
solar panel	太阳能电池板
spent nuclear fuel rod	废核燃料棒
spike in energy prices	能源价格的飙升
staggering 5 million new jobs	令人吃惊的500万个就业岗位
stake out different positions	表明了不同的立场
steer clear of	避开
stoke inflation	引发通货膨胀
superconducting magnetic energy storage	超导磁储能
supply shock	供给冲击
suspend the renewable fuel standard	暂停可再生燃料标准
switchgrass	柳枝稷
synfuel	合成燃料
tap underground heat	开采地热
The paths before us are well trodden.	我们面前是别人已经走过的路。
touted as	被吹捧为
true to form	同往常一样
uranium and plutonium	铀和钚
viability viable	可行性 可行的
volatile organic compound	挥发性有机化合物
warrant a reexamination of the fuel ethanol issue	有正当理由重新审视燃料乙醇问题
weapon proliferation nuclear proliferation	武器扩散 核扩散
weigh in on ethanol fuel	权衡了乙醇燃料问题
wreak havoc on	对……造成严重破坏

Task 2: Read the title and the subheadings of Text I to answer the following questions. Then read the first paragraph and identify the sentence which announces the content of the text.

1) What problem is the United States faced with?

____

2) What has been proposed as a solution to the problem?

____

3) What do the authors think of the proposed solution?

____

4) What does "Blowing in the Wind" mean? Why do the authors use this phrase?

____

5) What solution do the authors propose?

____

The sentence which announces the content of the text:

____

____

Task 3: Text I follows a Problem-Solution discourse pattern. Skim through the text and specify the problem, potential solutions, the authors' evaluation of the solutions, and their arguments.

Problem

Proposed solution

Negative evaluation—Rejection

Potential solutions (A) and (B)

Negative evaluation of solution (A)—Rejection

Positive evaluation of solution (B)—Acceptance

Final solution

The communicative purpose: To argue that ____
____.

Text I

The Green Job[7]

The U.S. economy is sensitive to high energy prices. An **aggressive push toward green power** would result in the net loss of millions of jobs. There is a better way forward.

Dustin Chambers and Dan Ervin

1 Unlike most products, electrical energy is **fraught with thorny economic issues**. These include market competitiveness (e.g., the generation and distribution of energy resembles **monopoly** more than perfect competition), the emission of pollution, and public safety. Consequently, government regulation of the power industry in some shape or form is common around the globe. Historically, when governments **enmesh themselves in** the regulation of industry, they have a nasty habit of micromanaging, picking "winning" firms and technologies. **True to form**, the current energy debate centers on what proportion of America's electric energy should be generated by "green" sources, and what form those "green" sources should take (e.g., wind, solar, biomass, etc.). The answer to these questions will have significant **ramifications** for the U.S. economy for decades to come. In what follows, we explore these economic ramifications in greater detail, and compare wind power (currently the cheapest source of green energy) with what we believe is the best energy option: Nuclear power.

2 Reliably affordable energy is important because swift surges in energy prices typically have harmful economic effects. Commonly called "**supply shocks**," high energy prices ultimately **stoke inflation**, reduce economic output, and swell the ranks of the unemployed. The process begins by raising production costs in **energy intensive industries** such as manufacturing and transportation. In response, these industries attempt to pass along these higher costs to their customers (typically other firms). This puts pressure on industries farther up the economic food chain to raise their prices, as they are forced to pay more for the goods and services they receive from **energy-intensive suppliers**. For example, high **diesel fuel** prices force trucking firms to raise the rates they charge retailers to move merchandise to their stores. Retailers, in turn, face higher costs which they attempt to pass along to their customers in the form of

higher retail prices. In this way, higher energy prices both directly and indirectly raise the cost of doing business, thereby increasing prices across the entire economy in a process called "**cost-push inflation**."

3 In addition to facing higher prices for virtually everything they purchase, households must also **contend with** higher energy expenses in the form of pricier gasoline, heating oil, natural gas, and electricity. Not surprisingly, households respond by **paring consumption**, which typically represents 70 percent of U.S. gross domestic product (GDP). The combination of declining sales and higher production costs squeeze corporate profits and force businesses to lay off workers and reduce output. In this way, a **spike in energy prices** ultimately fosters higher inflation, falling output, and rising unemployment.

Lessons from History

4 Although the **meltdown** of the U.S. housing market is principally to blame for the current recession, the massive run-up in energy prices that peaked in the summer of 2008 certainly played a role in the United States entering into recession later that year (indeed, some have argued that high energy prices prior to September 11, 2001 contributed to that year's recession). These downturns notwithstanding, the most oft-cited examples of energy-related supply shocks are the recessions of 1974 and 1980. Beginning in late 1973, the Organization of the Petroleum Exporting Countries (OPEC) initiated an embargo that led to a nearly fivefold increase in crude oil prices in the span of just one year. The following year, the U.S. economy was in recession. From the time the crisis began in October 1973 until the peak of the recession in May 1975, average prices rose by nearly 17 percent, economic output dropped by 2.4 percent, and unemployment soared from 4.6 percent to 9 percent. In the wake of the Iranian revolution of 1979, crude prices doubled, and the United States entered another period of recession. From July 1979 to July 1980, average prices surged 13 percent, output dropped 1.6 percent, and unemployment jumped from 5.7 percent to 7.8 percent.

5 Given this historical background, how will an aggressive push toward green energy affect the U.S. economy today? The Obama administration claims that a shift to green energy will create a **staggering 5 million new jobs** over ten years. A careful examination of data available from the Bureau of Labor Statistics **casts serious doubt on** the credibility of that estimate. As of May 2008, the *entire* electric utility industry (generation, transmission, and distribution) employed 401,550 workers, and the electric and power transmission equipment manufacturing industries employed a combined

259,530 workers, while the industries that provide the fuel (e.g., natural gas, oil, and coal) collectively employed 335,380 workers. Putting all of this together, the entire electric power industry—from the manufacturing of the equipment, to the mining and drilling of fuel, to the generation of power, and the ultimate delivery of that power to customers—employs just over 996,000 workers, or about 20 percent of the Obama green job estimate. Creating 5 million new "green" jobs is not even remotely credible.

6 What's more, most green job estimates ignore all of the jobs lost because of higher energy prices. In both the 1974 and 1980 recessions, the unemployment rate surged by 4.4 and 2.1 percentage points, respectively. As of May 2009, the U.S. labor force stood at 160 million workers. Therefore, every 1 percentage point increase in the unemployment rate results in nearly 1.6 million lost jobs. With this in mind, even if President Obama's energy policies create a mere 250,000 *green jobs*, the resulting high energy prices (which we discuss in greater detail below) are likely to slow economic growth and spur unemployment in the wider economy. Job losses outside of the energy sector equivalent to a miniscule two-tenths of a percentage point (0.2 percent) of the nation's labor force (250,000 jobs) would exactly **offset the green job gains**. In light of the U.S. economy's historic sensitivity to high energy prices, an aggressive push toward green power would likely result in the net loss of millions of jobs.

Blowing in the Wind

7 Having discussed the broader macroeconomic implications of the Obama administration's energy policy, we turn to a detailed comparison of wind and nuclear power. We focus on wind power because it is the current green energy frontrunner. According to the U.S. Department of Energy (DOE), the wind industry enjoyed 30 percent *annual* growth from 2003 to 2007, and represented 30 percent of all new domestic generation capacity in 2007. Moreover, the Obama administration is a strong supporter of wind power. Wind will likely be a major player in America's future green-energy portfolio.

8 Throughout recorded history, humans have harnessed wind energy for various applications. The Egyptians used sailboats to navigate the Nile approximately 7,000 years ago, while the Chinese developed windmills to pump water by 200 B.C. Despite this long experience utilizing wind power, man has been unable to fully overcome this technology's chief shortcoming: It neither produces energy nor does any work when the wind stops blowing (also known as the **intermittency problem**). Over the **millennia**, this problem has been **ameliorated** through the use of backup or storage systems. For

sailboats, it is muscle-power and oars; for water pumps, it is storage tanks. Unlike our ancient ancestors, modern engineers have struggled to develop cost-effective storage systems for wind-generated electricity.

9 That struggle continues today as researchers explore six different technologies to help boost wind's potential, including batteries, compressed air, capacitors, hydrogen generation and storage, flywheels, and **superconducting magnetic energy storage**; however, none of these is yet **commercially viable**. The only storage technology currently in operation in the United States is **pumped storage**, which consists of a large body of water (a lake or reservoir) and **turbines** attached to generators. During peak times, water can be quickly released from the lake, driving the turbines and generators, and thus producing hydroelectricity. During periods of low energy demand, such as at night, the process runs in reverse, with the turbines acting as pumps and moving water back into the lake. Unfortunately, this is an inefficient and costly way to store electricity, and thus is not a viable solution for wind energy. Consequently, electric companies rely on backup generation systems, typically natural gas-fired turbines, which must be rapidly brought on- and off-line with fluctuations in the wind and consumer demand.

10 One measure of the intermittency of an energy source is the **capacity factor**, which equals the ratio of the amount of electricity generated to the maximum amount a turbine could generate. Alternatively put, the capacity factor measures the *reliability* or *dependability* of an energy source. Using information from the American Wind Energy Association (AWEA), the average annual capacity factor for wind is 31.8 percent. This means that windmills produce just under one-third of their maximum potential output. Compare this with nuclear power plants, which are nearly three times as reliable as wind power. According to the DOE's Energy Information Administration (EIA), nuclear power achieved a capacity factor of 91.5 percent in 2007. Given the major intermittency problems of wind, what are the potential consequences of relying on such a **capricious energy source**?

11 Vattenfall Europe Transmission, a regional power company that services northeastern Germany and controls 41 percent of that nation's wind-generating capacity, is an instructive case study in how intermittency affects the daily operations of an electric transmission system. Like the United States, the transmission system in Germany is **antiquated** and limited in its ability to direct electricity outside a given region. However, unlike the American operators who generally schedule and coordinate power generators a day ahead, the unpredictability of wind forces Vattenfall to abandon daily scheduling approximately 50 percent of the time. Consequently, Vattenfall relies heavily on backup

generation systems to lessen fluctuations in customer demand and intermittent supply, which necessitates the frequent starting and stopping of backup electric generators, which is very costly and inefficient from both an economic and engineering perspective. All too often, these backup generation costs are not included in the cost estimates used in the green energy debate.

12 That being said, it would be a mistake to conclude that intermittency poses only logistical problems in the generation of electricity. In its most acute form, intermittency can give rise to complete or **rolling blackouts**. This nearly occurred in early 2008, when a cold front moved through Texas and unexpectedly reduced wind speeds. Electric output from wind turbines in the state plunged 82 percent, from 1,700 to a mere 300 megawatts, forcing power operators to implement rolling blackouts to avoid system failure. This event is especially disturbing when one considers that the DOE has extensively surveyed U.S. wind resources and concluded that the **panhandle** of Texas through Kansas and into the Dakotas is the **optimal region for wind turbines**.

13 Apart from the obvious public safety problems posed by **power outages**, their economic impact can be severe. The DOE estimates that the prolonged blackout hitting the northeastern United States on August 14, 2003 cost Americans $6 billion (or about $250 million per hour). While this blackout was not caused by a failure of green energy, it vividly illustrates the economic costs stemming from a prolonged power outage. India provides another example of the economic consequences of an unreliable electricity system. India's rapidly expanding market economy **belies** a legacy of policies that have left the nation with an **archaic transmission system** and a shortage of generating capacity. Consequently, the nation experiences blackouts on a regular basis. The World Bank reports that approximately 30 percent of business owners believe unpredictable electricity service is the main obstacle for the Indian economy. Despite the desperate need for additional generation capacity, India has struggled to find sites for new facilities, and environmental regulations have further slowed the development of generating assets. This challenge is further **exacerbated** by the uncertainty created by fear of future regulatory changes.

14 Scale is another area where **nuclear energy trumps wind power**. The latest nuclear reactor designs can produce up to 1,500 megawatts, as compared with the largest wind turbine, which generates a mere 5 megawatts. Ignoring differences in capacity factors, 300 wind turbines are required to equal one nuclear plant. If output reliability is taken into account, approximately 863 wind turbines are required to equal the output of one nuclear power plant.

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An Atomic Solution

15 All of this raises a natural question: If the public wants to eliminate pollution/CO_2 emissions, but green technologies fail to deliver both low cost and reliability, how can this policy objective be met? The answer lies with nuclear power. In the 1970s, with global energy prices surging, many developed nations took a keen interest in nuclear power. This golden age of nuclear power was not to last, as accidents at Three Mile Island in 1979 and Chernobyl in 1986 prompted many nations to either close their existing plants or placed moratoriums on constructing new ones. Over the ensuing 30 years, safety improvements along with nuclear waste-reducing breakthroughs have greatly increased the attractiveness of atomic power. When coupled with the ability to produce a reliably large quantity of pollution-free, low-cost energy (6.5 cents per kW·h, according to the Electric Power Research Institute, EPRI), it is no surprise that the industry's nuclear winter is beginning to thaw. According to the EPRI, Algeria, Argentina, Armenia, Azerbaijan, Belarus, Brazil, Bulgaria, Canada, Chile, China, Egypt, Finland, France, India, Indonesia, Jordan, Kazakhstan, Libya, Lithuania, Mexico, Morocco, Oman, Pakistan, Poland, Romania, Russia, Saudi Arabia, South Africa, Sweden, Turkey, Ukraine, Vietnam, the United Arab Emirates, the United Kingdom, and the United States are either considering or building new facilities. In addition to the 437 reactors in use today, the International Atomic Energy Agency predicts that 70 new plants will go online within the next 15 years, with 55 already under construction. Although construction cost estimates for the first nuclear plants to be built are high (between \$5 and \$7 billion), most knowledgeable observers believe that cost will decline as the United States retools the related industries needed to support a vibrant atomic power industry.

16 The **poster child** for nuclear power is France, which generates more than 80 percent of its electrical energy using atomic power. The French model is instructive on a number of levels. First, it demonstrates that nuclear power is highly scalable, meaning that nuclear power plants can be built in large numbers to meet the desired electric generation needs of an entire nation. By contrast, most renewable energy sources suffer from intermittency problems (e.g., wind and solar), limited natural resource availability (e.g., hydroelectric and biomass), and power grid distribution issues (i.e., the regions where the power is produced are isolated and not well connected to the existing electric utility grid). Consequently, ambitious green energy proposals, like that of the Obama administration, do not envisage renewable energy providing more than 20 percent of the U.S.'s electric

power needs.

17 A second notable feature of the French model is the significant strides made to reduce **radioactive waste**. Unlike the United States, which officially shunned the reprocessing of spent nuclear fuel from commercial reactors in 1977, the French have openly embraced it. While the science behind reprocessing is quite complex, the basic idea is surprisingly simple. Roughly 96 percent of **spent nuclear fuel rods** are recyclable. The French separate the **ancillary non-recyclable materials** from the recyclable **uranium and plutonium**, which are in turn recombined in a four-phase process to produce mixed oxide (MOX) fuel. This significantly reduces both total waste and the demand for newly mined uranium. Far from contributing to **weapon proliferation**, the MOX recycling approach creates no net increase in plutonium over the fuel cycle and can be used to convert weapons of mass destruction (WMD) into peaceful civilian energy Areva, the government-owned enterprise responsible for reprocessing France's spent fuel, has found that the reactors that use a 30 percent MOX and 70 percent conventional fuel mixture actually produce as much plutonium as they consume over the fuel cycle, thus significantly reducing nuclear proliferation fears.

France Trumps Germany

18 America is at an energy crossroad. **The paths before us are well trodden.** One path represents what we call the German Model, which relies on expensive and heavily subsidized wind and solar power (7.7 to 12.7 cents per kW·h for wind, and 64 to 87.4 cents per kW·h for solar). The other, less-traveled path represents what we call the French Model, which can produce vast, reliable quantities of cheap energy (6.5 cents per kW·h) safely while creating very little radioactive waste. Adopting the German Model will reduce employment and economic growth in the United States by forcing Americans to depend upon expensive and inherently unreliable sources of energy. Embracing the French Model will do the opposite.

19 However, America faces three significant hurdles if embarking on the French path. First, the cost of constructing new installations is **prohibitive**. No less a free market advocate than Adam Smith recognized the need for public investment in the projects that were both crucial to commerce but too expensive to be reasonably financed by the private sector. While Smith was principally concerned with bridges, canals, and roads, that list has since grown to include railroads, large commercial ports, interstate highways, airports, etc. It does not seem unreasonable to add nuclear power to this list, as the permit application and construction costs will likely exceed $5 billion for the first new

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reactors. In practice, this public investment could be either direct, following the example of the federal government's operation of nuclear facilities under the auspices of the Tennessee Valley Authority, or indirect, taking the form of loan guarantees.

20 The second major obstacle is the ever-present risk that future regulatory changes may forcibly shut down U.S. reactors. Nuclear installations typically have a 40- to 60-year lifespan, plenty of time for future administrations or Congress to change the rules of the game and mothball facilities being built today. Given the massive fixed (capital) costs involved in constructing new plants, many years of continuous operation are necessary to successfully recoup these sunk costs. Because the government is largely responsible for creating this regulatory risk, it must therefore bear the cost of assuming that risk. If the government constructs new facilities, this is achieved automatically. However, if policy makers wish to encourage private investment in nuclear energy, the government must also assume the role of loan guarantor, thereby shifting future regulatory risk from private investors to the public sector.

21 Finally, the third hurdle involves the reprocessing of spent nuclear fuel. The American people will not support atomic energy if it results in a massive buildup of radioactive waste. Areva has shown that reprocessing can be done effectively without increasing the danger of WMD proliferation.

Task 4: Read paragraphs 2-3 and work out the chain effects of a rapid rise in energy prices.

The main point: Reliably affordable energy is important because swift surges in energy prices typically have harmful economic effects. In other words, high energy prices ultimately stoke inflation, reduce economic output, and swell the ranks of the unemployed.

The chain effect: Energy prices rise → ______________________________ →
________________________ → ______________________________ →
________________________ → ______________________________ →

Example: Diesel fuel prices rise → ______________________________ →
________________________ → ______________________________ →
________________________ → ______________________________ →
________________________ →

Rhetorical strategy: ____.

Task 5: Answer the following questions according to paragraphs 4-6.

1) In what way is paragraph 4 related to paragraph 3?

____

2) What is the cause of the recession in 1974?

____

3) What is the result of the 1974 recession?

____

4) What is the cause of the 1980 recession?

____

5) What is the result of the 1980 recession?

____

6) What is the government's response to the energy problem today?

____

7) What do the authors think of the government's strategy?

____

8) For what purpose do the authors cite the figures from the Bureau of Labor Statistics?

____

Task 6: Supply the following types of information on the basis of the "Blowing in the Wind" section.

1) The communicative purpose of the section: ______________________________

____

2) The rhetorical strategies to achieve the purpose: ______________________________

____

3) The authors' choice of details: ______________________________

- Shortcoming of wind power: ______________________________
- Technical and commercial challenges: ______________________________
- Capacity factor: ______________________________
- Consequences of depending on wind power: ______________________________

Note: The authors frequently choose negative evaluative words and structures to express their negative attitude towards wind power. For example:

Despite this long experience utilizing wind power, man has been unable to fully overcome this technology's chief shortcoming: It neither produces energy nor does any work when the wind stops blowing (also known as the intermittency problem). Over the millennia, this problem has been ameliorated through the use of backup or storage systems. For sailboats, it is muscle-power and oars; for water pumps, it is storage tanks. Unlike our ancient ancestors, modern engineers have struggled to develop cost-effective storage systems for wind-generated electricity.

That struggle continues today as researchers explore six different technologies to help boost wind's potential, including batteries, compressed air, capacitors, hydrogen generation and storage, flywheels, and superconducting magnetic energy storage; however, none of these is yet commercially viable. The only storage technology currently in operation in the United States is pumped storage, which consists of a large body of water (a lake or reservoir) and turbines attached to generators. During peak times, water can be quickly released from the lake, driving the turbines and generators, and thus producing hydroelectricity. During periods of low energy demand, such as at night, the process runs in reverse, with the turbines acting as pumps and moving water back into the lake. Unfortunately, this is an inefficient and costly way to store electricity, and thus is not a viable solution for wind energy.

Task 7: Supply the following types of information on the basis of paragraphs 15-21.

1) The communicative purpose of the section: ____________________

2) The rhetorical strategies to achieve the purpose: ____________________

3) Choice of details: ____________________

4) Features of nuclear power: ____________________

5) Features of the French model: ____________________

6) The three hurdles: ____________________

7) The purpose of discussing the three hurdles: ____________________

Task 8: Determine whether the following statements are the authors' claims or evidence for their claims.

Note: A claim is a statement expressing an opinion, position, or generalization. Evidence is proof for or against a claim. For example:

- In this way, a spike in energy prices ultimately fosters higher inflation, falling output, and rising unemployment. (Para. 3: **claim**)
- Beginning in late 1973, the Organization of the Petroleum Exporting Countries (OPEC)

initiated an embargo that led to a nearly fivefold increase in crude oil prices in the span of just one year. The following year, the U.S. economy was in recession. (Para. 4: **evidence**)

1) From July 1979 to July 1980, average prices surged 13 percent, output dropped 1.6 percent, and unemployment jumped from 5.7 percent to 7.8 percent. (Para. 4)
2) Putting all of this together, the entire electric power industry—from the manufacturing of the equipment, to the mining and drilling of fuel, to the generation of power, and the ultimate delivery of that power to customers—employs just over 996,000 workers, or about 20 percent of the Obama green job estimate. (Para. 5)
3) Creating 5 million new "green" jobs is not even remotely credible. (Para. 5)
4) What's more, most green job estimates ignore all of the jobs lost because of higher energy prices. (Para. 6)
5) As of May 2009, the U.S. labor force stood at 160 million workers. Therefore, every 1 percentage point increase in the unemployment rate results in nearly 1.6 million lost jobs. (Para. 6)
6) In light of the U.S. economy's historic sensitivity to high energy prices, an aggressive push toward green power would likely result in the net loss of millions of jobs. (Para. 6)
7) During peak times, water can be quickly released from the lake, driving the turbines and generators, and thus producing hydroelectricity. During periods of low energy demand, such as at night, the process runs in reverse, with the turbines acting as pumps and moving water back into the lake. (Para. 9)
8) Unfortunately, this is an inefficient and costly way to store electricity, and thus is not a viable solution for wind energy. (Para. 9)
9) Vattenfall relies heavily on backup generation systems to lessen fluctuations in customer demand and intermittent supply, which necessitates the frequent starting and stopping of backup electric generators, which is very costly and inefficient from both an economic and engineering perspective. (Para. 11)
10) In its most acute form, intermittency can give rise to complete or rolling blackouts. (Para. 12)
11) Apart from the obvious public safety problems posed by power outages, their economic impact can be severe. (Para. 13)
12) Consequently, the nation experiences blackouts on a regular basis. (Para. 13)
13) Scale is another area where nuclear energy trumps wind power. (Para. 14)
14) If the public wants to eliminate pollution/CO_2 emissions, but green technologies fail to deliver both low cost and reliability, how can this policy objective be met? The answer lies with nuclear power. (Para. 15)

15) A second notable feature of the French model is the significant strides made to reduce radioactive waste. (Para. 17)

16) Adopting the German Model will reduce employment and economic growth in the United States by forcing Americans to depend upon expensive and inherently unreliable sources of energy. Embracing the French Model will do the opposite. (Para. 18)

Task 9: Read Text II and identify the authors' communicative purpose, their claim, and arguments.

Note: An argument is not just a claim; it is the reasoning and the use of facts to prove or disprove a claim.

The authors' communicative purpose: To argue that ________________________________

____

____

The authors' claim: ____

____

____

The authors' arguments against the ethanol mandate:

1) ____

____

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2) ____

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3) ____

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4) ____

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5) ____

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Text II

Is It Time to Stop Putting Food in Our Cars?[8]

The ethanol mandate continues to do more harm than good—inflicting environmental damage, raising food prices, and distorting energy markets.

Kenneth P. Green and Elizabeth Demeo

1 Two recent developments **warrant a reexamination of the fuel ethanol issue**. First, on August 20, 2012, the Environmental Protection Agency (EPA) issued a call for comments on **suspending the renewable fuel standard** (RFS), sometimes known as the **ethanol mandate**.

2 Second, though it has not played a feature role in the 2012 presidential election, both Governor Mitt Romney and President Barack Obama have **weighed in on ethanol fuel, staking out different positions**.

3 Our conclusions are that the ethanol mandate continues to do more harm than good—inflicting environmental damage, raising food prices, and distorting energy markets.

Ethanol and Food Prices

4 Projections estimate that by 2016, the United States will have diverted up to 43 percent of its cropland toward ethanol production. Since such land is normally used to harvest grain for feeding livestock, any diversions to ethanol production would require either changing the use of other land to growing grain or sharp increases in the cost of grain and meat. Given these **ramifications**, it is no surprise that **a myriad of global organizations** have opposed the biofuel mandate, including the World Trade Organization, Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development, International Monetary Fund, Organization for Economic Co-operation and Development, UN Conference on Trade and Development, World Food Program, International Food Policy Research Institute, UN High Level Task Force, and the World Bank. In a recent opinion piece in the Financial Times, Jose Graziano da Silva, director-general of the FAO, also called for the suspension of biofuel use. He noted that "an immediate, temporary suspension of the ethanol mandate would **give some respite to the market** and allow more of the crop to be channeled towards food and feed uses."

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Ethanol and Gas Prices

5 To offset the environmental harms listed above, many hope that ethanol will at least benefit the economy by helping to keep gas prices down. However, close inspection reveals that this is yet another energy myth: Ethanol will not shield us from high gasoline prices because, in a free market, the price of ethanol will be the same as gasoline, on an energy-equivalent basis—that is, the price of a gallon of ethanol should be around 66 percent of a gallon of gasoline, as it will take you the same distance when you drive on it. A 2008 report from National Renewable Energy Laboratory confirms this fact: The report reviews five independent studies to assess the impact of ethanol blending on gasoline prices in the United States, and concludes that they all "overestimate the impact of the substitution effect on driver economics, because the reduced gasoline production costs do not translate fully into savings for end consumers."

Environmental Impacts

6 Ethanol poses numerous environmental threats. One of the most serious is the overuse and destruction of land and water. According to scientists Jan Kreider and Peter Curtiss, refining a gallon of corn ethanol requires 35 gallons of water. But that is only the beginning. Kreider and Curtiss estimate that three times as much water is needed to grow the corn that yields a gallon of ethanol. That brings the tally to 140 gallons of water per gallon of corn ethanol produced. If their calculation is correct, the 5.4 million gallons of corn ethanol used in America in 2006 required the use of 760 million gallons of fresh water. Furthermore, note that these estimates are conservative by some more recent standards. As energy analyst Chris Nelder remarked: After reviewing a dozen or so academic papers and other sources, I concluded that a 2010 study by the Argonne National Laboratory was **in the right ballpark**. It estimated that it takes 82 gallons of water on average to produce 1 gallon of ethanol in the regions responsible for 88 percent of U.S. corn production, where the vast majority of that water is used for irrigation. Multiplying that by the 800,000 barrels per day of ethanol production shown in last week's IEA report suggests that the U.S. currently uses a little over one trillion gallons of water per year to make ethanol.

7 In addition to overuse, ethanol production pollutes the water we do have: In "Water Implications of Biofuels Production in the United States," the National Research Council points out that more corn raised for ethanol means more fertilizers, pesticides, and herbicides in waterways; more low-oxygen "dead zones" from **fertilizer runoff;** and

more local shortages in water for drinking and irrigation. Fertilizer runoff does not just pollute local waters. It creates other far-reaching environmental problems—destruction that is already evident in the Gulf of Mexico and the Chesapeake Bay. More is sure to come if we allow ethanol production to continue at its current pace.

8 Land is also threatened by ethanol production. In a *Science* article in February 2008, researchers calculated that producing 15 billion gallons of corn ethanol to meet U.S. ethanol goals would require the diversion of corn from 12.8 million hectares of U.S. cropland and would, in turn, bring 10.8 million hectares of additional land into cultivation. Locations would include 2.8 million hectares in Brazil, 2.3 million in China and India, and 2.2 million here in the United States. Current and future projections look similarly bleak: Brent Gloy, associate director of research at Purdue University's Center for Food and Agricultural Business, estimates that 20 million acres of U.S. land alone were used in 2011 to feed corn to ethanol plants. To **remedy the problem,** many scientists are now fixated on finding ways to get more out of available land.

9 Finally, there's the issue of climate change. In media reports, ethanol is often pitched as a good solution to climate change because it re-circulates carbon in the atmosphere; that is, it's "carbon-neutral." However, there is more than one kind of greenhouse gas to consider.

10 When blended with gasoline, ethanol actually increases the formation of potent greenhouse gases more than gasoline does by itself. As far back as 1997, the U.S. Government Accountability Office determined that the ethanol production process produces relatively more **nitrous oxide** and other potent greenhouse gases than does gasoline. In contrast, the greenhouse gases released during the conventional gasoline fuel cycle contain relatively more of the less-potent type, namely, carbon dioxide.

11 In 2008, Paul Crutzen, a Nobel Prize–winning chemist, validated these findings. Further research only confirms the trend: In February 2008, researcher Timothy Searchinger and colleagues calculated that "corn-based" ethanol, instead of producing a 20 percent savings, nearly doubles greenhouse gas emissions over 30 years and increases greenhouse gases for 167 years.

12 Although the EPA claims a net decrease in greenhouse gas emissions from using ethanol, it recognizes that ethanol creates air pollutants. Ethanol use, according to the EPA, will increase the emission of chemicals that lead to the production of ozone, one of the nation's most challenging local air pollutants. The Office of Transportation and Air Quality notes, "other vehicle emissions may increase as a result of greater renewable fuel use. Nationwide, EPA estimates an increase in total emissions of **volatile organic**

compounds and nitrogen oxides (VOC + NO_x) between 41,000 and 83,000 tons due to increased use of ethanol." Furthermore, the areas that experience a substantial increase in ethanol may see an increase in VOC emissions between 4 and 5 percent and an increase in NO_x emissions between 6 and 7 percent from gasoline-powered vehicles and equipment.

The Fiction of Cellulosics

13 Given the aforementioned environmental hurdles to producing corn-based ethanol, numerous researchers have proposed a shift to **cellulosic ethanol feedstocks** such as **switchgrass**. Though more difficult to **ferment**, the theoretical appeal of cellulosic feedstocks lies in their abundance, availability, and cheap cost relative to corn. In actuality, however, cellulosic-based ethanol fails to make good on this promise. One need only look at how the Energy Information Administration projections for cellulosic-based ethanol have changed to see that switchgrass and company cannot measure up to the scale of production offered by corn and other foodstuffs. Furthermore, many of the same environmental harms inherent in corn-based ethanol apply to cellulosic materials. For example, Searchinger and colleagues found in 2008 that biofuels from switchgrass, if grown on U.S. corn lands, increased greenhouse emissions by 50 percent. Similarly, land use projections remain bleak—Kreider and Curtiss estimate that switchgrass would require between 146 and 149 gallons of water per gallon of ethanol produced from cellulose, depending on the scale of production.

14 Despite the difficulty and danger involved in producing cellulosic biofuels, the EPA has continued to push them as corn-based ethanol's eco-friendly cousins. Though it is one thing to lobby hard for cellulosics like switchgrass, it is another entirely to force oil companies to make the switch, as the EPA did earlier this year when it began fining companies for failing to include non-existent cellulosic biofuels in gasoline and diesel. In January, the New York Times reported: When the companies that supply motor fuel close the books on 2011, they will pay about $6.8 million in penalties to the Treasury because they failed to mix a special type of biofuel into their gasoline and diesel as required by law. But there was none to be had. Outside a handful of laboratories and workshops, the ingredient, cellulosic biofuel, does not exist.

15 Charles T. Drevna, the president of the National Petrochemicals and Refiners Association, remarked that the EPA's action "belies logic."

Past Politics

16 Ethanol was initially **touted** by promoters **as** the solution to all our energy woes—dependence on foreign oil, diminishing oil stocks, and environmental consequences of energy use, to name a few. As recently as 2006, ethanol was thought by President Bush to be good for our rural communities. It's good economic development for rural America... Ethanol is good for the environment...good for drivers...Ethanol is good for the whole country.

17 It was this mindset that pushed Bush to sign the RFS into law in 2007, which mandated 13 billion gallons of ethanol (equivalent to 5 billion bushels of corn) be used in gasoline in 2012 alone, scaling up to nearly 14 billion gallons by 2013.

18 During the 2008 presidential election, both Obama and John McCain expressed similar support for ethanol, though it's worth noting that McCain was far later in coming to the ethanol game. On the eve of the Republican primary, candidate McCain appeared to have an **epiphany** regarding ethanol, changing his position to a strong endorsement of the substance while on the Iowa campaign trail. Given the swift and sudden nature of the shift, it is all but certain that McCain's support for ethanol was not a sincere endorsement grounded in scientific reasoning, but rather a political ploy conceived to **curry favor with** the Corn Belt crowd.

Obama's Stance

19 The president, it should be noted, "has been a strong believer in ethanol." Lest there be any doubt regarding Obama's feelings for this powerful fuel, his traveling press secretary Jennifer Psaki put it to rest during the president's recent trip to Iowa. When it comes to ethanol, she assured voters, "He absolutely believes in it."

20 Given the recent problems that have cropped up around the government's ethanol mandate, including rising food prices, drought, and a list of waiver requests from ranchers and state governors, one might be curious as to why Obama is choosing this moment to so strongly support the mandate. Might it have anything to do with the fact that ethanol is a vital source of jobs in Iowa and other critical swing states in the November 6 election?

21 According to Psaki the answer is (at least partially) yes: "He thinks it's a driver of the economy here in Iowa and a key component of renewable energy."

22 Given the numerous dangers of ethanol production outlined above, it is worth examining more closely how Obama and other politicians have responded to the ethanol mandate.

Romney's Position

23 Although Romney has also expressed support for the ethanol mandate, he has not gone out of his way to offer particulars on his position. In his recently released white paper on energy independence, Romney only briefly mentions that he will maintain the mandate, proclaiming that his administration will support increased market penetration and competition among energy sources by maintaining the RFS and eliminating regulatory barriers to a diversification of the electrical grid, fuel system, or vehicle fleet.

24 Note that Romney is particularly ambiguous on the details of how he will "maintain" the mandate, failing to include information about funding, an implementation structure, or even a timeline. And although Romney proclaimed during a May 2011 visit to Iowa, "I support the subsidy of ethanol. I believe ethanol is an important part of our energy solution for this country," his spokeswoman Andrea Saul clarified last year that Romney "supports ethanol but...doesn't believe any subsidy is permanent."

25 Given his lack of details on the RFS, it seems that the Romney camp may be taking a page from McCain's campaign playbook. In keeping his plans for the ethanol mandate under wraps, Romney gives himself the option to use the mandate as a bargaining chip, tweaking and refining his position to be the most politically viable at any given moment. For now, at least, the ethanol industry favors Romney's position. In a recent statement, Bob Dinneen, the CEO of the Renewable Fuels Association, explained: "By working to remove barriers to market access for renewable fuels, as Governor Romney suggests, America can help spur an economic recovery while securing our energy future."

What's Next?

26 Only time will tell just how much harm the ethanol mandate might do to the environment. At the moment, all we can do is consider the evidence at hand. We now know that ethanol—whether derived from corn or switchgrass—has not only **failed to live up to the hype**, but will do America more harm than good as it continues **wreaking havoc on** our air, land, and sea, not to mention our wallets.

27 Perhaps Romney or Obama will have the courage to step up and tackle America's ethanol problem in the way it should be solved: By having an open discussion, regardless of the political implications of the truth, about ethanol's many costs and few benefits. Such a discussion will surely make the right course of action—to kill the mandate immediately—quite clear. For now, it is worth noting that a bright spot does exist: Romney's running mate, Paul Ryan, has been quite vocal about his support for killing the

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ethanol mandate.

Task 10: Read Text III and note down the main points.

The author's communicative purpose: To argue that geothermal energy gets too little attention, although it is greener than wind and solar.

The advantages of geothermal energy:

1) ____

____

2) ____

____

3) ____

____

The technical process to tap geothermal energy:

1) ____

____

2) ____

____

3) ____

____

The author's suggestions: ______________________________

____

____

____

Text III

Hot Rocks, Cool Technology[9]

Greener than wind or solar, geothermal energy gets little attention—even though it could provide 2,000 times our current power needs.

Nick Schulz

1 A promising, but largely unrecognized, source of clean, renewable energy is right beneath your feet. It's geothermal energy, which comes from the super-hot rocks just under the Earth's crust. The United States is the global leader in geothermal, which

provides about the same amount of power as the combined output of wind and solar energy, says MIT geophysicist M. Nafi Toksöz. That's not much, but it could be a great deal more. Right now, geothermal gets little attention from environmentalists, traditional energy companies, or governments.

2 This lack of attention is all the more surprising since geothermal is a greener source of power than either solar or wind. But if several **intrepid scientists** and engineers are right, advanced-technology geothermal will get the respect it now lacks.

3 The idea is simple—**tapping underground heat** to generate electricity. The Earth's core emits enormous amounts of heat, which, when combined with water—either naturally in hydrothermal reservoirs, or artificially—creates the steam needed to turn a turbine and produce electricity.

4 The idea isn't new. Geothermal electricity was first generated in 1904 in Larderello, Italy, in a part of Tuscany called Valle del Diavolo—Valley of the Devil, known for boiling liquids that rise to the surface. Italian engineers slapped an electricity generator on top of their Hades, and the first geothermal installation was born. Today, Iceland generates 15 to 20 percent of its electricity this way.

5 The problem for large-scale development of geothermal energy is that the planet's underground heat is not evenly distributed. In the U.S., for example, hot rocks are closer to the surface in Western states such as California, Utah, and Nevada than elsewhere. The largest and best-known U.S. geothermal installation is located at The Geysers, just north of San Francisco. Run by the Calpine Corporation, this field generates more electricity than any other in the world: 850 megawatts—enough to provide power for a million households.

6 In the 1970s, scientists affiliated with the Los Alamos National Laboratory wondered if they could tap heat located far deeper underground. If so, they figured, geothermal energy could be harnessed just about anywhere. They established the technological foundation for what they called Hot Dry Rock heat extraction and patented the idea in 1974.

7 Under this process (also known as Enhanced Geothermal Systems or "EGS"), wells are drilled into burning subterranean rock, which can be miles below the surface. Water is pumped down at high pressure, creating a reservoir amid the cracks and fissures in the rock. The water is returned to the surface, where hydrothermal energy is extracted to create electricity. The water is then recirculated. According to a paper from Los Alamos scientists, "In this closed-loop process, nothing is released to the environment except heat, and no long-term wastes accumulate." Unlike with fossil fuels, no CO_2 or other

greenhouse gases are produced.

8 And the ecological advantages geothermal enjoys over other alternatives are considerable. It doesn't compete with food crops like biomass does, and it can provide base-load electricity without the need for coal, nuclear, or natural gas as backups, unlike wind and solar. Also, a geothermal operation has a far smaller footprint than windmills and **solar panels**. Geothermal is as green as it gets.

9 So what's the potential for harnessing much more of the Earth's natural heat to meet our electricity needs? To find out, the U.S. Department of Energy and MIT **convened a panel** in 2005 to investigate the **viability** of large-scale geothermal energy use. The report was issued on January 22.

10 "Using reasonable assumptions regarding how heat would be mined from stimulated EGS reservoirs," the authors say, the extractable portion would exceed "about 2,000 times the annual consumption of primary energy in the United States in 2005." And heat mining may be economical, even in the short term.

11 The tools for making geothermal energy extractable were developed by the oil and gas industry. Brian Anderson, a professor at West Virginia University who worked on the study, notes that advances in drill-bit technology, materials science, and the fracturing of rocks—which have made it possible to go after fossil fuels in deep and inhospitable environments—can also be used for deep-heat mining.

12 None of the oil, gas, or coal companies, however, is yet taking geothermal seriously. Anderson says that one reason the big energy firms are reluctant is that they "lack the expertise needed to connect geothermal installations to the **electricity grid**." Another is that, for all its potential, geothermal will likely take decades to replace even one-tenth of the electricity generated by coal or natural gas.

13 So for now, geothermal is largely the **province of government-backed efforts** and specialist firms such as Nevada-based Ormat Technologies, Inc., a publicly traded company with a market cap of $1.3 billion that operates a total of 370 megawatts of generating capacity globally, about two-thirds of which is in the U.S. (A single nuclear plant typically has a capacity of about 1,500 megawatts.)

14 Meanwhile, major government-sponsored efforts are underway in Soultz-sous-Forêts, France, and in Australia's Cooper Basin. The MIT paper argues that projects like these are promising enough to warrant U.S. government funds in "support of EGS as a long-term 'public good,' similar to early federal investments in large hydropower dam projects and nuclear power reactors."

15 There's a good argument that governments should **steer clear of** subsidizing any form

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of energy. Federal involvement, even in energy research and development, has been fitful and haphazard—and probably counterproductive. Remember **synfuels**? The **flavors of the month** now include biomass and hydrogen, both with strong political constituencies—but for how long? In the end, like every other energy source, geothermal should have to prove itself in the marketplace. Even without government help, it may eventually do just that.

Task 11: Discuss the advantages and disadvantages of wind energy, solar energy, nuclear energy, geothermal energy, bio-fuels, etc. and decide which type of green energy you support. Write a short essay to promote one type of energy. You can focus on the following points.

- Some general remarks about the widespread concern over energy shortage
- Efforts made to develop renewable energy sources
- The type of energy you promote or argue for and its positive features

Task 12: Complete the following science report with the words or word chunks you hear.

On July 5, 1977, a group of scientists and engineers opened the Solar Energy Research Institute in the Colorado foothills of the Rocky Mountains. By 1980, the outfit had a budget of $100 million (1) ______________________ research and development of photovoltaics and solar thermal power. They also strove to educate the public about solar power and (2) ________________________.

Such sunny dreams faded during the Reagan administration but the scientific outfit rebounded in the early 1990s, now called the National Renewable Energy Laboratory. Its mandate expanded to everything from algae-based biofuels to harnessing the (3) ___________________ in (4) _______________________ .

Now NREL is turning 35, and such sources remain a small fraction of the U.S. energy supply, despite precipitous drops in the cost of (5) _____________ like (6) ______________. More than 80 percent of U.S. energy still comes from burning coal, oil and, more and more, (7) ____________________ .

In addition, recent government efforts to boost the future of (8) ______________ in the U.S. have ended in bankruptcy, from Solyndra to, more recently, Abound Solar. So there's plenty of work to be done to make renewable energy a reality. To avoid catastrophic climate change, let's hope it doesn't take another 35 years.

Task 13: Note down the main points of Prize–winning New York Times columnist Tom Friedman's talk about his new book: Hot, Flat, and Crowded: Why We Need a Green Revolution—and How It Can Renew America.

1) Hot, Flat, and Crowded refers to the three big seismic events:

- ____
- ____
- ____

2) The five problems in the 21^{st} century as a result of the three seismic events:

- ____
- ____
- ____
- ____
- ____

3) The basic argument: ________________________________

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Task 14: Note down the main points of an interview about "A Solar Grand Plan" published in the Scientific American magazine.

1) Past articles say: ________________________________

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Reason: ____________________________________

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2) This "Solar Grand Plan" article says: ________________________

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Reason: ____________________________________

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3) What is required is: ________________________________

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4) Land requirement: ________________________________

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5) Reaction from the people in Arizona: ________________________

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6) The concern of the people in Arizona: ____
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7) Estimate of power generation by 2050: ____
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8) Two big assumptions for the plan:
- ____
- ____

9) The economic implications: ____
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10) Political implications: ____
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11) Other advantages of solar power: ____
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Task 15: Complete the following notes according to what you hear.

1) From 2010 to 2020 roughly, the federal government would have to supply about (1)________ in subsidies to build the (2) ____________ systems, (3) ____________ systems, (4) ________________ systems, (5) ________________ system. By 2050, all the components of this new industry would be (6) ________________.
2) It's a lot of money. But it's actually (7) ________________what was spent to create the whole (8) ________________, which completely remade the system of commerce in the country.
3) The federal government invested in the Internet connection first and then the (9) _______. That's the way cancer research works in this country too, where the federal government (10) ______________ and then the pharmaceutical companies (11) ________________ and develop the drugs (12) ______________. So, it's really the standard business model.
4) It's how lots of things get done, (13) ______________systems, (14) ________________ systems. That's how essentially the government is putting in (15) ________________.
5) The cost of not doing it: (16) ________________ cost a lot of money and have a lot of (17) ________________; this plan will also reduce (18) ________________to about a third of what they are now by 2050.

Task 16: Watch a debate over the proposition "What the world needs now is nuclear energy" and summarize the main reasons for supporting or not supporting the statement.

The main reasons for supporting the statement:

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The main reasons for NOT supporting the statement:

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