**Sequenceplan**

**Topic**: Alternative Fuels

**Promoted Competences**: Content Knowledge, Evaluation, Communication, Gaining-of-Insight, Competence to Act Accordingly, Intercultural Competence, Language Competence (based on the Science and English Curricula of Lower Saxony, Germany)

**Prior Knowledge:** Alcohol, (alkanes), (gasoline)

**Thematic Frame**: The students are on a trip to partake in a science exchange in northern Canada (Inuvik, Northwest Territories) together with Canadian students. The topic of the project is alternative fuels. Since the science equipment for chemistry classes in the North is limited, the German students have to bring a lot of the chemicals and materials needed to do the project. Therefore, the students will drive by bus from Edmonton to Inuvik through the Canadian wild. During one of the stops, the gasoline is sold out hindering the continuation of the trip.

**Homework before the start of the first lesson**: To prepare themselves for their stay abroad in Canada, students have to read an information brochure detailing the trip. While reading, they have to answer a few questions in order to test their comprehension

\*\*Please note: All accompanying materials are in English. However, some of the scaffolding gives German translation of unknown English words. This has to be adapted before the materials can be used in bilingual chemistry classes other countries.

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| **Week** | **Topic** | **Content of the Lesson** | **Competences** | **Materials** |
| **Day 1**  **November 24th** | Arrival in Edmonton; Topic „Alternative Fuels“  Problem: After the first day, the bus runs out of gasoline. No gas station can be found for another 100 km. | 1. Introduction into the “project“ (10 min) 2. „Arrival“ in Canada. Bus trip to Inuvik. Analysis of the problem (no gas) (10 min) 3. Students inform themselves in groups of 4-5 about five different types of alternative (ethanol, biodiesel, hydrogen, natural gas, electricity) und develop an information poster in English. (40 min) 4. Gallery Walk in new groups to present the posters.(10 min) 5. Class discussion about which fuel is best suited to continue the trip (10 min)   Homework: Think about which fuels are suitable and how they can be produced. | Content Knowledge   * Students describe the types of alternative fuels. * Students recognize characteristics of alternative fuels.   Evaluation   * Students describe advantages and disadvantages of alternative fuels.   Communication   * Students present their work. * Students research information on alternative fuels. * Students use sources of information.   Competence to Act Accordingly   * Students act accordingly in new linguistic situations * Students use grammar and vocabulary adequately   Language Competence   * Students derive meaning of words from the context. | computer, beamer, PowerPoint  scotch tape  posters  markers  bell  Information texts on alternative fuels |
| **Day 2**  **December 1st** | Experiment: Production of biodiesel (from canola oil) or ethanol ( from yeast, sugar and water ) | 1. Class: Crisis situation: Which alternative fuel can be produced so that the class can reach the next gas station 100 km away. (Review from the previous week) (10 min). Class decides which 2 alternative fuels can be made.(5 min) 2. In groups: students carry out experiments and write lab reports to document the experiments for the Canadian students (30-40 min) 3. Teacher experiment: comparison of flashpoints and emissions of biodiesel, ethanol and diesel. (10 min) Students decide which fuel they want to put in their bus. (5 min) 4. Class: Continuation of the trip and arrival in Inuvik. (5 min) | Evaluation   * Students decide which alternative fuel they can use.   Gaining-of-Insight   * Students carry out experiments to investigate and produce alternative fuels.   Communication   * Students write lab reports to document their experiments. * Students experiment in groups. * Students explain facts to each other   Competence to Act Accordingly   * Students act accordingly in new situations in English. * Students use grammar and vocabulary adequately   Language Competence   * Students derive meaning of words from the context. | computer, beamer, PowerPoint  methanol, canola oil, yeast, sugar    Worksheets:  How to write a lab report. Template.  Experiment Procedures  Picture dictionary of lab equipment |
| **Day 3**  **December 8th** | Theoretical background: alkanes, production of biodiesel, alcohol fermentation, environmental pollution of alternative fuels | 1. Summary of alternative fuels (5 min) Realization that students lack theoretical knowledge. 2. Learning by stations: (4 stations, 20 min each) 1. Alkane as Fuels 2. Production of Biodiesel 3. Alcohol Fermentation 4. Environmental Pollution of Alternative Fuels Didactic reserve: 5. Energy for the Production of Ethanol 3. Class: Summary of the theoretical content of the lesson. (5 min) | Content Knowledge   * Students classify substances as energy carriers. * Students recognize structural and chemical characteristics of alternative fuels. * Students recognize ester bonds, alkanes and the difference between esterification and hydrolysis.   Evaluation   * Students describe advantages and disadvantages of alternative fuels.   Gaining-of-Insight   * Students derive chemical contents.   Competence to Act Accordingly   * Students act accordingly in new situations in English. * Students use grammar and vocabulary adequately   Language Competence   * Students derive meaning of words from the context. | computer, beamer, PowerPoint  worksheets and questions for the stations  answer sheets  help cards  blackboard, chalk |
| **Day 4**  **December 15th** | Review and Fish-Bowl Discussion | 1. Summary and Review of alternative fuels with the whole class (15 min), Understanding of a new problem. 2. Development of arguments for the discussion: Advantages and disadvantages of alternative fuels for the given problematic situation  Group 1: Pro: ethanol Group 2: Pro: biodiesel  (25 min) 3. Fish-Bowl Discussion with the whole class. Different roles assigned to students for feedback (content, language, professional knowledge, etc.)(20 min) 4. Results/Feedback (10 min) 5. Survey to investigate reception of the bilingual unit. (15 min) | Communication   * Students use sources of information. * Students critically discuss advantages and disadvantages of alternative fuels keeping in mind pollution. * Students argument according to topic. * Students chose topic-relevant and meaningful information.   Evaluation   * Students recognize the importance of energy transmitting reactions in their environment. * Students recognize, discuss and evaluate the meaning of energy carriers. * Students understand the social meaning of the sciences.   Gaining-of-Insight   * Students develop problem-solving strategies.   Intercultural Competence   * Students get to know different points of view. * Students consider different points of view. * Students develop their own opinions about topics.   Competence to Act Accordingly   * Students act accordingly in new situations in English. * Students use grammar and vocabulary adequately   Language Competence   * Students derive meaning of words from the context. | Newspaper article about Inuvik’s fuel problem  Worksheet to help with the discussion  blackboard / chalk  survey |