

Student support materials for geography aqa as geogr Online PDF

student support materials for geography aqa as geogr

Preparing effectively for your AQA Geography AS Level (AS Geogr) exams requires access to high-quality student support materials. These resources are designed to enhance understanding, improve exam technique, and build confidence in tackling complex geographical concepts. Whether you're a student seeking revision guides, practice questions, or comprehensive notes, the right support materials can make a significant difference in your academic performance. In this article, we will explore the essential student support materials available for AQA Geography AS Geogr, how to utilize them effectively, and tips for maximizing your study sessions.

Understanding the AQA Geography AS Level Syllabus

Before diving into support materials, it's crucial to understand the structure and content of the AQA Geography AS Level syllabus. This knowledge ensures you select resources aligned with your exam specifications.

Syllabus Overview

The AQA AS Geogr curriculum typically covers the following core themes:

- Physical Geography: Landforms, rivers, coastal processes, and climate change
- Human Geography: Population dynamics, urban issues, and resource management
- Geographical Skills: Map reading, data interpretation, and fieldwork techniques

Understanding these themes helps in choosing targeted support materials that address each area effectively.

Types of Student Support Materials for AQA Geography AS Geogr

To excel in your AS Geography exams, students should utilize a variety of support resources. Below are the main types of materials available:

1. Textbooks and Revision Guides

Standard textbooks tailored for AQA AS Geogr provide comprehensive coverage of the syllabus, including explanations, diagrams, and case studies. Popular revision guides often condense key information, making them ideal for quick review.

- Recommended Titles:

- Geography for AQA AS and A Level by John Wakelen
- AQA Geography AS Student Book by David Redfern
- Collins AQA Geography for AS and A Level Revision and Practice

2. Practice Question Papers and Mark Schemes

Practicing past papers is essential for understanding exam style, time management, and question formats. These materials help students identify common question types and develop effective answers.

- Access past papers on the official AQA website
- Utilize mark schemes to understand examiner expectations
- Attempt timed practice to simulate exam conditions

3. Topic-Specific Revision Notes and Summaries

Condensed notes focusing on key concepts, definitions, and case studies are invaluable for quick revision. Many online platforms provide free or paid summaries tailored for AQA AS Geogr.

4. Interactive Quizzes and Flashcards

Engaging with quizzes and flashcards reinforces memory and understanding. These tools are especially useful for memorizing case studies, terminologies, and processes.

5. Video Tutorials and Lectures

Visual learners benefit from online videos explaining complex concepts, demonstrating fieldwork techniques, or analyzing geographical data.

Effective Strategies for Using Support Materials

Having a variety of resources is beneficial, but knowing how to use them effectively is key. Here are

some strategies:

1. Create a Study Plan

Organize your revision schedule around the syllabus themes, allocating time for reading, practice questions, and review sessions.

2. Use Active Learning Techniques

Instead of passively reading, engage with the materials by highlighting key points, making mind maps, or teaching concepts to a peer.

3. Practice Under Exam Conditions

Simulate exam scenarios by timing yourself during practice questions. Review your answers critically using mark schemes to identify areas for improvement.

4. Focus on Case Studies and Data Interpretation

Many questions require application of knowledge to specific case studies. Support materials often include these; ensure you understand their relevance and details.

5. Review Regularly

Frequent revision helps transfer knowledge from short-term to long-term memory. Use flashcards and quizzes for quick daily reviews.

Additional Resources and Support Platforms

Beyond textbooks and practice papers, several online platforms and communities provide additional support:

- **AQA Official Website:** Provides syllabi, specimen papers, and examiner reports
- **Revision Websites:** such as Seneca Learning, Physics & Maths Tutor, and Save My Exams
- **YouTube Channels:** Offer tutorials and revision tips, e.g., Geography Tube, Mr. Smith's

Geography

- **Study Groups and Forums:** Collaborative platforms like The Student Room facilitate peer support and resource sharing

Tips for Choosing the Right Support Materials

Selecting suitable resources can enhance your revision efficiency. Consider the following:

- **Alignment with the Syllabus:** Ensure materials match the current AQA specification
- **Clarity and Accessibility:** Look for resources that are easy to understand and well-organized
- **Variety:** Use a mix of reading, visual, and practical resources to cater to different learning styles
- **Up-to-date Content:** Prefer recent editions and materials that reflect the latest syllabus changes

Conclusion

Effective preparation for the AQA Geography AS Geogr exam hinges on the strategic use of diverse student support materials. From comprehensive textbooks and revision guides to practice papers and interactive resources, each plays a vital role in building knowledge and exam confidence. Remember to tailor your study plan to include a variety of these materials, stay consistent with your revision, and actively engage with the content. By utilizing these resources wisely, you'll be well-equipped to achieve your academic goals and excel in your Geography AS Level exams.

Student support materials for Geography AQA AS Geogr are essential tools that help students excel in their AS level geography coursework and examinations. In an increasingly competitive academic environment, having access to high-quality, targeted resources can make a significant difference in understanding complex geographical concepts, mastering case studies, and developing essential skills such as data analysis and essay writing. This review explores the range of available support materials, analyzing their features, benefits, and potential limitations, to guide students and educators in selecting the most effective tools for success.

Overview of Student Support Materials for Geography AQA AS Geogr

Support materials for AQA AS Geography are designed to complement classroom learning, providing revision aids, practice questions, interactive activities, and detailed explanations of key topics. These resources are produced by a variety of publishers, educational websites, and independent tutors, often tailored specifically to the AQA specification. The primary goal is to enhance understanding, boost confidence, and improve exam performance.

Key types include textbooks, revision guides, online platforms, practice question books, and multimedia resources. The diversity of available materials ensures that students can find resources suited to their preferred learning styles—whether they favor visual aids, interactive exercises, or detailed text explanations.

Textbooks and Printed Revision Guides

Features

- Comprehensive coverage aligned with AQA specification
- Clear diagrams, maps, and case studies
- End-of-chapter summaries and review questions
- Glossaries of key terms
- Practice exam questions with mark schemes

Pros

- In-depth explanations suitable for thorough understanding
- Structured layout facilitates systematic revision
- Often include additional resources like practice exams and worksheets
- Widely available and relatively affordable

Cons

- Can be bulky and less portable
- Sometimes too detailed for quick revision
- May become outdated if not regularly updated

Popular examples include the AQA Geography for AS series and Collins? Geography AQA AS Revision and Practice. These are often recommended by teachers for their accuracy and depth.

Online and Digital Resources

Features

- Interactive quizzes and activities
- Video tutorials explaining complex topics
- Dynamic maps and data analysis tools
- Up-to-date case studies and current events integration
- Mock exams and timed practice questions

Pros

- Highly engaging and interactive
- Accessible anytime with an internet connection
- Often free or low-cost
- Allows for self-paced learning and immediate feedback

Cons

- Requires reliable internet access
- Can be distracting if not well-structured
- Quality varies between platforms

Notable platforms include Seneca Learning, Physics & Maths Tutor, and Quizlet, which host a plethora of flashcards and quizzes tailored for AQA Geography students. Teachers also recommend YouTube channels such as GeoGraphy with Mr. Mc and Geography All the Way for visual explanations and case studies.

Practice Question Books and Exam Guides

Features

- Focused on exam preparation
- Includes past paper questions with model answers
- Tips and strategies for exam techniques
- Time management advice

Pros

- Helps students familiarize themselves with exam format
- Builds confidence through practice
- Identifies areas needing improvement

Cons

- May focus more on exam technique than content understanding
- Risk of over-reliance on practice questions at the expense of broader understanding

Popular titles include AQA AS Geography Practice Questions and Exam Success for AQA

Geography. These resources are particularly useful during revision periods and for mock exam preparations.

Interactive and Multimedia Resources

Features

- Virtual field trips and simulations
- Interactive maps and GIS tools
- Podcasts and interviews with experts
- Animated diagrams and infographics

Pros

- Enhance engagement and motivation
- Help visual and kinesthetic learners
- Facilitate understanding of spatial and environmental data

Cons

- May require specific software or hardware
- Can be less comprehensive in covering all syllabus areas

Platforms such as Google Earth, ArcGIS Online, and dedicated geography apps provide immersive experiences and real-world data analysis opportunities, enriching classroom and self-study sessions.

Key Features and Effective Use of Support Materials

To maximize the benefits of these resources, students should consider the following:

- **Alignment with the Syllabus:** Ensure materials are tailored to the AQA AS Geogr specification to avoid gaps.
- **Active Engagement:** Use interactive and practice resources regularly rather than passively reading or watching.
- **Combination of Resources:** Mix textbooks, online activities, and practice questions for a well-rounded approach.

- Regular Review: Schedule revision sessions using different materials to reinforce learning.
- Seek Feedback: Use model answers and teacher feedback to improve exam technique and understanding.

Advantages of Using Student Support Materials Effectively

- Improved Understanding: Clarifies complex geographical processes and concepts.
- Enhanced Exam Skills: Familiarity with question formats and mark schemes boosts confidence.
- Broader Knowledge Base: Exposure to diverse case studies and current issues.
- Time Management: Practice questions help develop exam pacing skills.
- Motivation and Engagement: Interactive elements and multimedia resources make learning more enjoyable.

Limitations and Challenges

Despite their many benefits, support materials have limitations:

- Over-reliance: Students might depend too heavily on resources and neglect developing independent critical thinking.
- Cost: Some high-quality textbooks and online courses can be expensive.
- Quality Variability: Not all resources are equally well-produced or accurate.
- Technological Barriers: Access issues may arise for students without reliable internet or suitable devices.
- Outdated Content: Rapid changes in environmental issues or case studies require regularly updated materials.

Conclusion: Choosing the Right Support Materials

Effective preparation for AQA AS Geography hinges on selecting the right combination of support materials tailored to individual learning styles and needs. Textbooks and revision guides provide foundational knowledge, while online platforms and multimedia resources enhance engagement and understanding. Practice question books are invaluable for exam readiness, and interactive tools bring geographical data and concepts to life.

Ultimately, the most successful students integrate diverse resources, maintain consistent revision schedules, and actively apply their knowledge through practice and reflection. Educators should also guide students in evaluating and selecting high-quality materials to ensure their study time is both efficient and effective. With the right support materials and strategic use, students can confidently approach their AQA AS Geography exams and develop a deep, lasting understanding of

the world around them.

QuestionAnswer What are the most effective student support materials for AQA Geography A-Level? Effective materials include detailed revision guides, interactive online quiz platforms, annotated case study summaries, and tailored practice questions that align with AQA specifications. How can I use student support materials to improve understanding of physical geography topics? Utilize visual aids like annotated diagrams, video tutorials, and case study examples to deepen understanding, alongside practice questions that reinforce key concepts and processes. Are there specific support materials recommended for case studies in AQA Geography A-Level? Yes, comprehensive case study sheets, up-to-date summaries, and dedicated revision booklets provide concise information and key facts to aid memorization and application. How do student support materials help with exam preparation for AQA Geography? They offer structured revision, targeted practice questions, and exam technique tips, helping students familiarize themselves with question styles and improve time management during exams. Where can I find free online student support materials for AQA Geography AS and A-Level? Many resources are available on the official AQA website, revision blogs, educational YouTube channels, and platforms like Seneca Learning and Quizlet that provide free, high-quality support materials.

Related keywords: geography revision notes, AQA geography AS, geographical skills, physical geography resources, human geography materials, map skills practice, case study examples, exam tips geography, geographical terminology, AS geography coursework

MATERIALS DEVELOPMENT UAH

Materials development UAH is a critical process in the academic and research sectors, especially within the context of the Ukrainian higher education system. As universities and research institutions strive to enhance their educational resources, innovate teaching methodologies, and foster cutting-edge research, the development of high-quality materials becomes paramount. This article provides an in-depth overview of materials development at UAH, exploring its significance, key components, strategies, challenges, and best practices to optimize educational outcomes.

Understanding Materials Development at UAH

Materials development at UAH (National University of Kyiv-Mohyla Academy) involves creating, adapting, and implementing educational resources tailored to meet the evolving needs of students, faculty, and researchers. It encompasses a broad range of materials, including textbooks, digital content, laboratory manuals, case studies, multimedia tools, and assessment instruments.

Significance of Materials Development in UAH

Effective materials development is essential for several reasons:

- **Enhancing Learning Outcomes:** Well-designed materials facilitate better understanding, critical thinking, and application of knowledge.
- **Supporting Innovative Teaching:** Modern resources enable educators to adopt active learning strategies, including flipped classrooms, blended learning, and online modules.
- **Aligning with Academic Standards:** Developing materials aligned with national and international educational standards ensures quality and relevance.
- **Fostering Research and Innovation:** Specialized materials support research activities and promote scholarly dissemination.

Key Components of Materials Development at UAH

Effective materials development involves multiple interconnected components:

1. Needs Assessment

Identifying the specific requirements of students and faculty is the first step. This involves surveys, feedback sessions, and reviewing curriculum goals to determine gaps and areas for improvement.

2. Content Creation and Adaptation

Developing original content or adapting existing materials to suit local contexts, languages, and academic levels is crucial. This includes ensuring cultural relevance and accessibility.

3. Use of Technology and Multimedia

Incorporating digital tools, multimedia elements, and interactive platforms enhances engagement and accommodates diverse learning styles.

4. Quality Assurance

Implementing peer reviews, pilot testing, and iterative revisions ensures the accuracy, clarity, and pedagogical effectiveness of materials.

5. Dissemination and Accessibility

Ensuring materials are easily accessible through online repositories, university libraries, or learning

management systems (LMS) maximizes their impact.

Strategies for Effective Materials Development at UAH

To optimize the process, UAH employs various strategies:

1. Collaboration and Interdisciplinary Approach

Facilitating teamwork among faculty from different departments fosters the creation of comprehensive and innovative materials.

2. Incorporation of Modern Pedagogical Principles

Applying principles such as constructivism, active learning, and formative assessment enhances the relevance and effectiveness of materials.

3. Emphasis on Digital Transformation

Leveraging digital platforms like Moodle, Canvas, or custom portals allows for dynamic content delivery and student interaction.

4. Continuous Updating and Improvement

Regular reviews, incorporating feedback, and staying abreast of new research ensure materials remain current and effective.

5. Training and Professional Development

Providing faculty with workshops and resources on best practices in materials development enhances their capacity to produce high-quality content.

Challenges in Materials Development at UAH

Despite its importance, materials development faces several challenges:

- **Resource Limitations:** Budget constraints can restrict access to cutting-edge technology and expert support.
- **Language Barriers:** Developing materials in Ukrainian, English, and other languages to cater to diverse student populations can be complex.
- **Technological Infrastructure:** Variability in digital infrastructure across departments may

hinder the integration of digital content.

- **Faculty Expertise:** Not all educators may have training in instructional design or digital content creation.

- **Maintaining Quality:** Ensuring consistent quality across a wide range of materials requires rigorous review processes.

Best Practices for Materials Development at UAH

To overcome challenges and enhance effectiveness, UAH adopts several best practices:

1. Establish Clear Standards and Guidelines

Developing institutional policies on content quality, accessibility, and pedagogical standards ensures consistency.

2. Foster a Culture of Collaboration

Encouraging interdisciplinary teams and partnerships with industry experts enriches content quality.

3. Utilize Open Educational Resources (OER)

Incorporating OER allows for cost-effective access to high-quality materials and fosters sharing among institutions.

4. Invest in Faculty Training

Providing ongoing professional development in instructional design, digital tools, and assessment methods strengthens capacity.

5. Engage Students in Material Development

Involving students in feedback and pilot testing helps tailor materials to actual needs and preferences.

Future Trends in Materials Development at UAH

Looking ahead, materials development at UAH is poised to evolve with technological advancements:

- **Artificial Intelligence (AI):** AI-driven content personalization and adaptive learning systems will tailor materials to individual student needs.

- **Virtual and Augmented Reality:** Immersive experiences can enhance understanding in fields like medicine, engineering, and history.
- **Open Access and Collaborative Platforms:** Expanding open repositories and collaborative tools will promote wider sharing and continuous improvement.
- **Data-Driven Decision Making:** Analytics will inform the development and refinement of materials based on student engagement and performance metrics.

Conclusion

Materials development at UAH is a vital component of advancing higher education quality, fostering innovation, and supporting research excellence. By focusing on needs assessment, leveraging technology, adopting best practices, and addressing challenges proactively, UAH can continue to produce relevant, engaging, and effective educational materials. As the landscape of education evolves with technological innovations, ongoing investment and strategic planning will ensure that UAH remains at the forefront of materials development, ultimately benefiting students, faculty, and the broader academic community.

For institutions seeking to enhance their educational resources, understanding the multifaceted process of materials development at UAH provides valuable insights into creating impactful learning environments that prepare students for the future.

Materials Development UAH: Pioneering Innovations in Material Science

Introduction

Materials development UAH (Universidad de Alcalá) has emerged as a significant hub for pioneering advancements in the field of material science. This institution's dedicated efforts towards understanding, designing, and optimizing new materials are shaping the future of industries ranging from aerospace to biomedicine. As the global demand for innovative, sustainable, and high-performance materials continues to rise, UAH's research initiatives are instrumental in pushing the boundaries of what is scientifically possible. This article delves into the core aspects of materials development at UAH, exploring the university's research focus, technological breakthroughs, and the broader impact on society.

Understanding Materials Development at UAH

Materials development at UAH is a multidisciplinary endeavor that integrates principles from chemistry, physics, engineering, and environmental science. The goal is to create materials with tailored properties suited for specific applications, often emphasizing sustainability, durability, and efficiency.

Key Objectives of UAH's Materials Development Program

- Innovate New Materials: Developing novel compounds with enhanced characteristics.
- Improve Existing Materials: Enhancing the performance and lifespan of current materials.
- Sustainable Solutions: Promoting environmentally friendly materials with reduced ecological footprints.
- Application-Focused Research: Customizing materials for sectors like energy, healthcare, and manufacturing.

The university's approach combines fundamental research with applied sciences, ensuring that discoveries are not only scientifically significant but also commercially viable.

Core Research Areas in Materials Development at UAH

The university's materials development efforts span several pivotal sectors, each with its unique challenges and opportunities.

Advanced Nanomaterials

Nanotechnology has revolutionized material science, allowing for the manipulation of matter at atomic and molecular scales. UAH's research in nanomaterials includes:

- Nanocomposites: Combining nanoparticles with polymers or metals to produce materials with superior strength, electrical conductivity, or thermal properties.
- Nanostructured Coatings: Developing protective and functional coatings with enhanced corrosion resistance, self-cleaning capabilities, or antimicrobial properties.
- Quantum Dots: Exploring applications in imaging, sensing, and energy conversion.

These nanomaterials are pivotal in developing lightweight, high-strength components for aerospace or electronics.

Sustainable and Eco-Friendly Materials

With environmental concerns at the forefront, UAH emphasizes the development of sustainable materials, including:

- Biopolymers: Deriving plastics from renewable biological sources to replace conventional plastics.

- Recycling-Optimized Materials: Designing materials that facilitate easier recycling or biodegradation.
- Energy-Efficient Materials: Developing thermal insulators or phase-change materials for energy conservation.

This focus aligns with global efforts to reduce ecological footprints and promote circular economy principles.

Functional Materials for Energy

Energy-related applications are a major research theme, including:

- Battery Materials: Creating electrodes with higher capacity, faster charging, and longer lifespan.
- Supercapacitors: Developing materials that enable rapid energy storage and release.
- Photovoltaic Materials: Enhancing the efficiency of solar cells through novel semiconductor compounds.

These advancements contribute to the transition toward renewable energy sources and sustainable power storage solutions.

Biomedical Materials

In healthcare, UAH's research aims to produce materials with biocompatibility and functionality:

- Tissue Engineering Scaffolds: Designing biomaterials that support cell growth and tissue regeneration.
- Drug Delivery Systems: Developing nanoparticles and hydrogels for targeted therapy.
- Antimicrobial Materials: Creating surfaces resistant to bacterial colonization, vital in hospitals and medical devices.

Such innovations improve patient outcomes and reduce healthcare-associated infections.

Technological Breakthroughs and Innovations

UAH's research has led to several notable breakthroughs that demonstrate the university's leadership in materials development.

Development of High-Performance Composite Materials

Researchers at UAH have engineered composites that combine lightweight properties with exceptional strength, suitable for aerospace and automotive industries. For example, polymer-based composites reinforced with carbon nanotubes exhibit superior tensile strength and electrical conductivity, enabling lighter aircraft and vehicles with better fuel efficiency.

Eco-Friendly Coatings with Self-Healing Capabilities

A novel class of coatings developed at UAH can repair minor damages autonomously, extending the lifespan of infrastructure and reducing maintenance costs. These self-healing coatings often contain microcapsules that release healing agents upon crack formation.

Sustainable Bioplastics from Agricultural Waste

By converting agricultural residues into bioplastics, UAH's team has created an alternative to traditional petroleum-based plastics. These bioplastics maintain comparable strength and flexibility while degrading more rapidly in the environment.

Next-Generation Energy Storage Materials

Research into novel electrode materials has resulted in batteries with higher energy densities and faster charging times. Such innovations are crucial for electric vehicles and portable electronics, making renewable energy more accessible and practical.

Collaborations and Industry Partnerships

Materials development at UAH benefits significantly from collaborations with industry and governmental agencies. These partnerships facilitate:

- Technology Transfer: Moving laboratory discoveries into commercial production.
- Funding Opportunities: Securing grants for large-scale research projects.
- Real-World Testing: Validating materials under operational conditions.

Some notable collaborations include partnerships with aerospace firms, renewable energy companies, and healthcare providers, ensuring that research outcomes are aligned with market needs.

Educational and Societal Impact

Beyond research, UAH emphasizes education and societal outreach:

- Curriculum Development: Integrating cutting-edge materials science into undergraduate and graduate programs.
- Workshops and Seminars: Promoting knowledge sharing among students, researchers, and industry professionals.
- Public Engagement: Raising awareness about sustainable materials and their importance for future generations.

This holistic approach ensures that innovations in materials science translate into tangible benefits for society and foster the next generation of scientists and engineers.

Future Directions and Challenges

While UAH has made significant strides, several challenges remain:

- Scalability: Ensuring laboratory discoveries can be translated into cost-effective manufacturing processes.
- Environmental Impact: Continually assessing the life cycle and ecological footprint of new materials.
- Material Safety: Addressing potential health risks associated with nanomaterials and other advanced compounds.
- Interdisciplinary Integration: Fostering collaboration across diverse scientific fields to develop truly innovative solutions.

Looking ahead, the university aims to harness emerging technologies like artificial intelligence and machine learning to optimize material design and accelerate discovery processes.

Conclusion

Materials development UAH exemplifies a dynamic intersection of scientific innovation, sustainability, and practical application. By advancing the frontiers of nanotechnology, eco-friendly materials, energy storage, and biomedical innovations, the university is not only contributing to academic knowledge but also impacting industries and society at large. As the world grapples with challenges related to climate change, resource scarcity, and technological demands, UAH's dedicated research and development efforts stand as a beacon of hope and progress in the quest for smarter, greener, and more resilient materials.

Question What is the focus of materials development at UAH? The focus of materials development at UAH (University of Alabama in Huntsville) is on creating advanced materials for aerospace, defense, and technology applications, including composites, nanomaterials, and electronic materials. How does UAH integrate materials development into its research programs?

UAH integrates materials development through interdisciplinary research centers, collaborations with industry partners, and dedicated labs that focus on innovative material synthesis, characterization, and testing. What are some recent breakthroughs in materials developed at UAH? Recent breakthroughs include the development of lightweight composite materials for aerospace applications, novel nanostructured materials for electronic devices, and high-temperature materials for defense systems. How does UAH support student involvement in materials development projects? UAH offers undergraduate and graduate research opportunities, specialized coursework, and internships that allow students to participate directly in materials development projects and gain hands-on experience. What industries benefit from UAH's materials development research? Industries such as aerospace, defense, electronics, automotive, and renewable energy benefit from UAH's materials development research, which helps improve performance, durability, and sustainability. Are there any notable collaborations between UAH and industry partners in materials development? Yes, UAH collaborates with companies like NASA, Boeing, and Lockheed Martin to develop new materials that meet the demanding requirements of aerospace and defense sectors. What funding sources support materials development at UAH? Funding comes from federal agencies such as NASA, DARPA, and the Department of Defense, as well as grants from industry partners and research foundations dedicated to advancing materials science. How does UAH stay at the forefront of emerging materials technologies? UAH maintains its leadership by investing in state-of-the-art laboratories, recruiting top researchers, participating in cutting-edge research initiatives, and fostering collaborations with industry and government agencies. What are the future directions for materials development at UAH? Future directions include developing smart materials with embedded sensors, sustainable and environmentally friendly materials, and next-generation composites for space exploration and advanced electronics.

Related keywords: materials development, UAH, Ukrainian aerospace materials, composite materials, aerospace engineering, material science, advanced materials, aircraft materials, structural materials, university aerospace research

Read the full article online: [MATERIALS DEVELOPMENT UAH](#)