Vocational educational concept

School	Zespół Szkół Chemicznych Wł ocławek (PL)	
Field	Vocational education and training	
Vocational fields	Environmental Engineer / Environmental Technician	
Vocational field of action	„Work in the chemistry laboratory“	
Unit of learning outcomes (ULO) Total time in lessons (1 lesson = 45 minutes)	ULO 1: Chemical and physico-chemical processes lead (environmental studies) 1st year: 152 lessons (4 lessons per week) 2nd year: 136 lessons (4 lessons per week) 3rd year: 152 lessons (4 lessons per week)	
Work tasks and time in lessons	1. Chemical water investigations 2. Determination of the conductivity 3. Determination of COD 4. Determination of the carbonate hardness and total hardness 5. Determination of synthetic interface-active substances	4 lessons 4 lessons 4 lessons 4 lessons

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	6. Determination of calcium in a soil sample	4 lessons 4 lessons
Phases of the learning process	• orientation, theoretical considerations • actions, practical implementation • monitoring and evaluation of action and results	
Didactic features	• Introduction, motivation, action orientation, reactivation, goal orientation • Practical appropriation • consolidate, deepen the skills in operational practice	
Evaluation / monitoring / evaluation of results	1. Written controls 2. Oral controls 3. Practical controls 3.1. Work Result 3.2. Product Review	

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Learning Outcomes		
Knowledge (theoretical + practical) *Scientific and theoretical context*	***Skills*** *practical + cognitive* *(=application of knowledge)*	***Competence*** *(Role and level of responsibility and autonomy)*
• The properties of chemical substances used Knows (GHS hazard statement) • Names relationships between measurement and determination of size and corresponding method (known action steps) and the calculation relations for the determination of physical quantities • Knows appropriate equipment and devices and their operation / handling (analytical balance, pH meter, photometer, conductivity meter)	• Takes orders for determining the water content, the CSB, of surface-active substances, the conductivity of the calcium content and alkalinity of liquid and solid samples and plans to further work steps up to the handover of the results • Selects method that appropriate laboratory equipment and chemicals necessary and goes exactly, carefully and routinely order • Performs repeated measurements on the same samples by in order to reach a consensus successive measurements	• Operates independently for work regulations • independently verified results and solutions • Formulated the influence of the monitored parameters (eg., Temperature) to the measured values • Raises potential problems, find alternative measuring methods for the task • Works in the implementation of regulations and safety regulations

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• Describes the principles of the procedures and methods (argentometry, spectroscopy, volumetrics, Conductometry, Warth Piper method) • Does dependence measuring sizes of the environment (temperature, pressure, cleanliness, humidity, etc.) • The importance of accuracy and thoroughness knows when measuring and calculating • Has knowledge of safety rules and regulations	• Performs the measurements with extreme accuracy, with a focus on purity of the equipment used • Processes the results in tables, performs calculations • Comparing with the chemically pure substances the results with the values in the tables	

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Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
1. Chemical water investigations			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Chemical and physico-chemical analysis of waste water • importance of wastewater treatment • Effects on the environment • importance of water acidity • Basics volumetrics	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel video
Action, practical implementation **Time: 3,5 lessons**	<u>Chemical water investigations</u> • Determination of water content by titration with NaOH: Using the indicators methyl orange and phenolphthalein	demonstration Practical work	Instructions for the trainer / teacher Instructions for students
Monitoring and evaluation of action and results **Time: 0.5 lessons**	• calculation of the acid content • Evaluation of results	3. Practical controls: 3.1 Work Result 3.2 Product Review	Instructions for the trainer / teacher Literature regulations

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Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
2. Determination of the conductivity			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Chemical and physico-chemical analysis of waste water • importance of wastewater treatment • importance of the study to determine the water quality of surface waters • Effects on the environment • Basics Conductometry	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel regulations
Action, practical implementation **Time: 3,5 lessons**	<u>Determination of the conductivity</u> • determining the conductivity of distilled water • determining the conductivity of surface water • determining the conductivity of wastewater	demonstration Practical work	Instructions for the trainer / teacher Instructions for students
Monitoring and evaluation of action and results **Time: 0.5 lessons**	• calculate the conductivity of the sample solution KCl • calculate the conductivity of the sample	3. Practical controls: 3.1 Work Result 3.2 Product Review	Instructions for the trainer / teacher Literature regulations

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Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
3. Determination of COD			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Chemical and physico-chemical analysis of waste water • importance of wastewater treatment • Quality control in the wastewater treatment plant • Effects on the environment • Basics of argentometry	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel regulations
Action, practical implementation **Time: 3,5 lessons**	<u>Determination of COD</u> • Analysis of waste water (operation of a wastewater treatment plant) • measurement of the pH • Determination of chloride content using argentometry • application of the dichromate method for COD determinationg	demonstration Practical work	Instructions for the trainer / teacher Instructions for students
Monitoring and evaluation of action and results **Time: 0.5 lessons**	• importance of the chloride ions in the determination of COD • Calculation of the CSB of the wastewater samples • Interpretation and evaluation of results	3. Practical controls: 3.1 Work Result 3.2 Product Review	Instructions for the trainer / teacher Literature

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			regulations
Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
4. Determination of the carbonate hardness and total hardness			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Chemical and physico-chemical analysis of waste water • importance of wastewater treatment • Quality control in the wastewater treatment plant • Effects on the environment • Basics of Conductometry	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel regulations
Action, practical implementation **Time: 3,5 lessons**	<u>Determination of the carbonate hardness and total hardness</u> • Use of the method according to Warth-Pfeifer	demonstration Practical work	Instructions for the trainer / teacher Instructions for students
Monitoring and evaluation of action and results **Time: 0.5 lessons**	• calculation of the carbonate and total hardness	3. Practical controls: 3.1 Work Result 3.2 Product Review	Instructions for the trainer / teacher Literature regulations

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Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
5. Determination of synthetic interface-active substances			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Chemical and physico-chemical analysis of waste water • importance of wastewater treatment • Quality control in the wastewater treatment plant • Effects on the environment • Basics extraction and spectroscopy	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel regulations
Action, practical implementation **Time: 3,5 lessons**	<u>Determination of synthetic interface-active substances</u> • Investigation of waste water on which the content of surface-active substances • surfactants form with methylene blue a blue color complex • extraction with chloroform • Visual Determination of surface-active substances • preparation of a calibration line • measurement of the intensity of the colored chloroform layer with the photometer	demonstration Practical work	Instructions for the trainer / teacher Instructions for students color scale spectrophotometers

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Monitoring and evaluation of action and results **Time: 0.5 lessons**	• Creation of a calibration line • Grafische Auswertung der Proben und Bestimmung des Gehaltes an grenzflächenaktiven Substanzen	3. Practical controls: 3.1 Work Result 3.2 Product Review	Instructions for the trainer / teacher graph paper example calculations literature Regulations

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Phase of the learning process	**Content of work tasks**	**Organizational form of teaching (methodology)**	**Required Documents / Learning Supporting resources**
6. Determination of calcium in a soil sample You are an employee in a laboratory at the Center for Agricultural Consultancy, which analyzed the soil on the usefulness of the agricultural objectives. Your task is the quantitative and qualitative determination of the content of calcium ions in the soil. As a method for the processing of the task is the management of the Centre for Agricultural Consultancy titrating. Please follow the rules and enter the percent content of calcium in the soil.			
Orientation, theoretical considerations **Time: 0,5 lessons**	• Influence of calcium in the soil and on the development of the plant • volumetry / titration • use of indicators	Motivation Teachers lecture, class discussion	Instructions for the trainer / teacher panel
Action, practical implementation **Time: 3,5 lessons**	<u>Determination of calcium in a soil sample</u> • diluting and preparing solutions • Titration of the prepared soil samples • Reading of the volume of consumed NaOH	demonstration Practical work	Instructions for the trainer / teacher Instructions for students
Monitoring and evaluation of action and results **Time: 0.5 lessons**	• Calculation of the content of calcium • Interpretation of results and comparison with predetermined values	3. Practical controls: 3.1 Work Result	Instructions for the trainer / teacher literature

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